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United States Coast Guard

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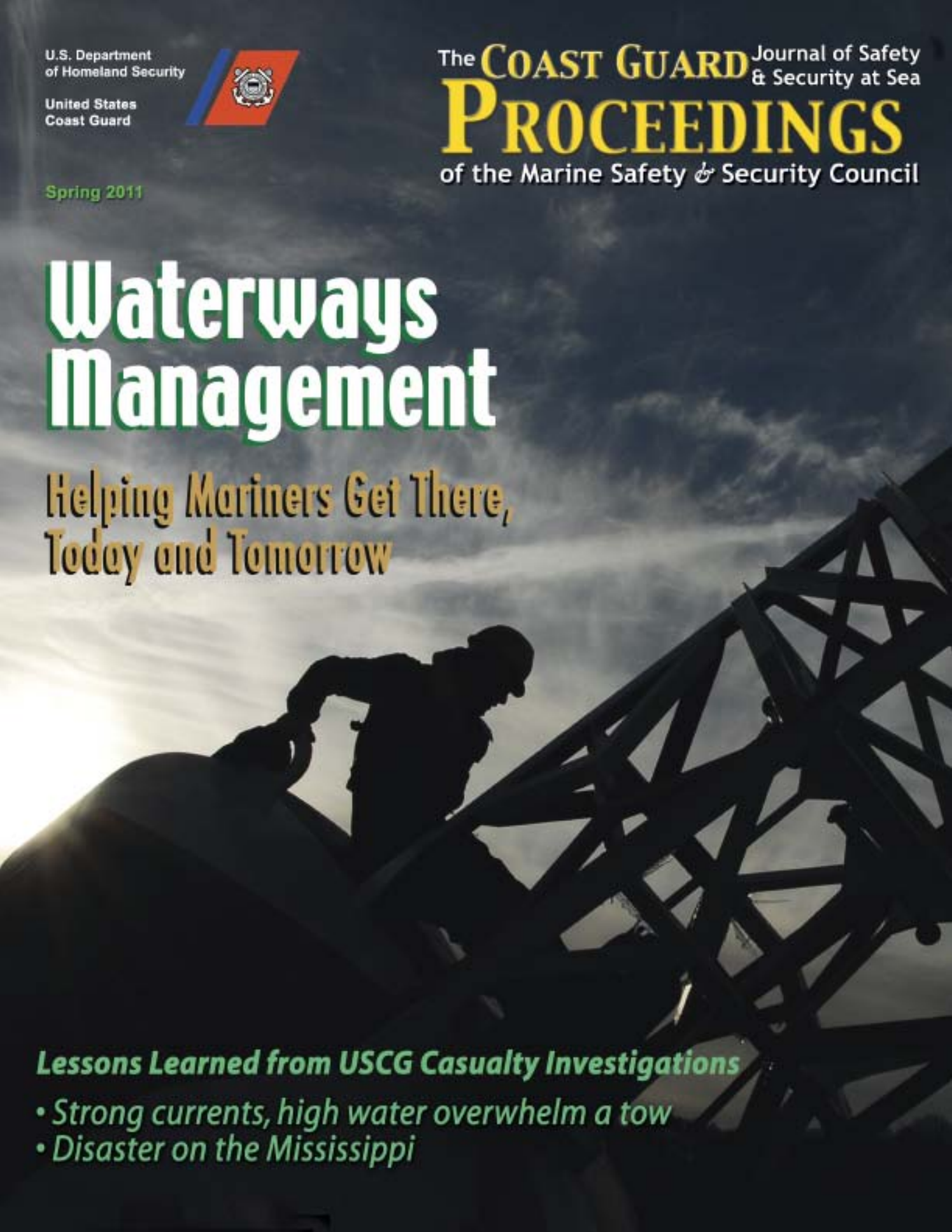
PROCEEDINGS

of the Marine Safety & Security Council

Spring 2011

Waterways Management

Helping Mariners Get There, Today and Tomorrow



Lessons Learned from USCG Casualty Investigations

- Strong currents, high water overwhelm a tow
- Disaster on the Mississippi

PROCEEDINGS

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Vol. 68, Number 1

Domestic Waterways Management

6 **Visual Aids to Navigation**
Dispelling the myths.
by Mr. Robert Trainor

10 **The "Black Hull" Fleet**
Multi-function assets for multi-mission duty.
by CDR Gregory Tlapa

16 **How Narrow is "Narrow"?**
NAVSAC recommends the Coast Guard develop navigation criteria.
by Mr. Craig H. Allen, Sr.

19 **Offshore Renewable Energy Installations**
Impact on navigation and marine safety.
by Mr. George H. Detweiler, Jr.

22 **Collaborating to Mitigate Risk**
The tools that guide the process.
by LCDR Tony Maffia, Mr. George H. Detweiler, Jr. and Mr. Burt Lahn

25 **Improving the Marine Event Permit Program**
by LCDR Ellis H. Moose

28 **Abandoned and Derelict Vessel Removal**
Understanding the process can ensure success.
by LCDR Charles Bright

32 **The San Francisco Bay Region's Harbor Safety Committee**
Communication and collaboration fuel success.
by Ms. Joan Lundsrom

36 **Pilotage**
One of the oldest yet least-understood maritime professions.
by Captain Michael R. Watson

39 **Domestic Icebreaking Operations**
by LT Benjamin Morgan

International Initiatives

42 **Vessel Traffic Services as Information Managers**
Growing and improving information sharing to match stakeholders' unique needs.
by CDR William Burns

45 **Developing Navigation Standards**
The IMO Subcommittee on Safety of Navigation.
by Mr. Edward J. LaRue, Jr.

48 **e-Navigation**
Revolution and evolution.
by Mr. Bill Cairns

51 **The Automatic Identification System**
Then, now, and in the future.
by Mr. Jorge Arroyo

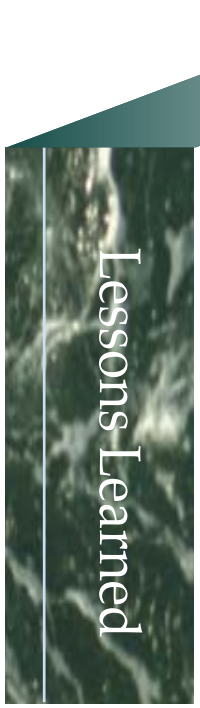
58 **Coast Guard Cooperation in the Arctic**
USCGC *Healy*'s continental shelf mission.
by LCDR Michael Krause and Dr. Jonathan Berkson

61 **International Ice Patrol**
Guardians on the Grand Banks.
by CDR Lisa Mack

Lessons Learned from USCG Casualty Investigations

64 **Against the Flow**
Strong currents, high water overwhelm a tow.
by Ms. Carolyn Steele

73 **Flying Blind**
Thick fog, faulty communications, and inexperience lead to disaster on the Mississippi.
by Ms. Carolyn Steele



On Deck

4 **Director's Perspective**
by Mr. Dana Goward

5 **Champion's Point of View**
by CAPT Pauline Cook

18 **Upcoming in Proceedings**

83 **Chemical of the Quarter**
Understanding Muds
by Mr. Thomas Jordan

Nautical Queries
84 Engineering
85 Deck

On the Covers:

During Operation Fall Retrieve, Coast Guard personnel switch all buoys in the Great Lakes with more durable ice buoys before winter.

Front cover: CGC *Alder* Fireman Mathew Stuber climbs down from a buoy.

Back cover: *Alder*'s deck force waits to pull a buoy onto its deck. U.S. Coast Guard photos by Petty Officer 3rd Class William B. Mitchell.

Director's Perspective

by Mr. Dana Goward, *Director*
U.S. Coast Guard Marine Transportation Systems Management Directorate

Lighthouses, pilotage, icebreaking, limited access areas, traffic separation schemes … if it helps mariners get there, chances are the Marine Transportation Systems (MTS) Management Directorate at CG headquarters is either responsible for it or has a big piece of it. On the one hand, our directorate is a new organization. On the other, our 10 functional programs have been Coast Guard responsibilities for decades. That the service has chosen to create our organization and highlight the programs to a greater extent reflects the importance the Coast Guard places on the MTS, a national asset that contributes over $750 billion to the U.S. GDP each year.

In 2010 the Coast Guard devoted more than 4,000 people and $1.4 billion to ensuring the MTS functioned well. In this edition of *Proceedings* you will learn about the kinds of things those people did, and how a lot of that money was spent.

Coast Guard support of marine transportation is facing a number of challenges. These include:

- Aging boats and ships that maintain visual aids to navigation across the nation. Some boat types are more than 35 years old, and some ship classes are over 45 years old.
- The need to modernize marine navigation and realize the efficiencies and improvements of "information age" technologies.
- Near-ubiquitous reliance on GPS for safe navigation and its vulnerabilities to interference and jamming.
- Protecting our sovereign rights and fulfilling our responsibilities in our Arctic waters.
- Outdated policy and guidance on a wide variety of aids to navigation and waterways management issues, and a diminishing base of experienced people.
- A growing list of bridges designated as unreasonable obstructions to navigation.
- The need to engage states, localities, other federal agencies, and maritime stakeholders on a wide variety of offshore renewable energy projects and other coastal/marine spatial planning issues.

Addressing all these challenges is an "all hands" effort. As the headquarters program managers, we will be doing our level best to advocate for the needs and interests of our Coast Guard and public constituents and provide the best policy guidance available. And, of course, we will communicate all of this as effectively as we can through a wide variety of media—such as this edition of *Proceedings*. Enjoy!

ADM Robert J. Papp Jr.
Commandant
U.S. Coast Guard

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Champion's Point of View

by CAPT Pauline F. Cook, *Deputy Director*
U.S. Coast Guard Marine Transportation Systems Management Directorate

Because marine transportation systems management is such a broad mission area within the Coast Guard, this issue of *Proceedings* is just a sampling of the marine transportation systems management that occurs in the field and at headquarters. It is intended to update readers on the latest developments for many of the areas traditionally covered under the waterways management umbrella.

As Mr. Goward explains in the "Director's Perspective," the headquarters Marine Transportation Systems Management Directorate covers 10 different and distinct programs. Some are principally managed at headquarters because they are either still developing, or they require extensive outreach with our international partners. For instance, "e-Navigation" is still evolving and is expected to be enforced as a body of international standards for all electronic navigational aids on ships internationally and on the shore.

If you come from the maritime community, you may recognize many of the topics pertaining to Captain of the Port authorities and waterways management—marine event permitting, AIS tracking and monitoring, marine debris removal, icebreaking (polar and domestic), and aids to navigation. Other topics such as dredging operations, anchorage management, limited access areas, pier construction permits, port authority liaisons, traffic separation schemes, regulated navigation areas, bridge program authorities, Great Lakes pilotage, and waterways suitability assessments did not make it into this issue, but definitely fall under marine transportation systems management. If you are interested in any of these topics, keep a "weather eye" for them on the newly created CGWeb portal at www.uscg.mil/hq/cg5/cg55, as a number of them will be appearing with links to information and the offices responsible for associated policies.

With the stand up of the U.S. Coast Guard Marine Transportation Systems Management Directorate last summer, it was decided that the use of the term "waterways management" was not descriptive enough for many outside the Coast Guard to understand the extent of the Coast Guard's responsibilities in this area. As you can see from the sample list of topics above, the responsibilities are expansive, and if you are responsible for the entire portfolio or just a portion, this issue is for you. We hope you enjoy reading it. Please let us know if this issue was beneficial to broadening your understanding of waterways and MTS management.

Visual Aids to Navigation

Dispelling aid availability myths.

by Mr. Robert Trainor
Aids to Navigation Specialist
U.S. Coast Guard Office of Navigation Systems

Aid availability[1] for the United States visual aids to navigation system is calculated monthly by the U.S. Coast Guard Marine Transportation Systems Management Directorate's Visual Aids to Navigation Division. These calculations can be presented by criticality category and broken down to various responsibility and servicing levels, including district, sector, servicing unit, waterway, and individual aid to navigation.

Frequent updates and convenient data presentation lead many waterways managers to assume that aid availability provides a comprehensive assessment of the health and effectiveness of aids to navigation (ATON) in their waterways as well as the efficiency of their ATON service delivery units. This mistaken assumption has perpetuated the following aid availability myths:

- Aid availability is proportional to recurring ATON funding levels.
- Aid availability provides an accurate assessment of an ATON service delivery unit's efficiency.
- Unscheduled maintenance of ATON service delivery platforms (cutters and boats) or emergency diversion to other mission areas directly impacts aid availability.
- Aid availability is primarily impacted by ATON component reliability.

An aids to navigation team services a small foam buoy. All photos USCG.

Aids to Navigation Discrepancies

Aid availability is impacted by unplanned outages, or ATON discrepancies, and the Coast Guard's ability to respond to and correct them.[1]

In 2005 the Coast Guard specified maximum maintenance intervals of 36 months for buoys and lighted beacons and 60 months for unlighted beacons. Specific maintenance intervals for individual aids are determined after considering component reliability and service life, environmental factors, wildlife, vandalism, and other factors.

The USCG uses a discrepancy response factor—a numerical indicator measuring the criticality of the discrepant ATON—to prioritize response. The higher the number, the more critical the aid is to safe navigation, and hence the higher the priority for response and correction.

Endnote:

1. An ATON discrepancy occurs when an aid is unable to perform its intended function or exhibit its advertised characteristics. The visual aids to navigation system suffers an average of 10,200 discrepancies annually, which encompasses nearly 29 percent of the total ATON population.

Dispelling the Myths

Myth—Aid availability is proportional to recurring ATON funding levels. This is predicated on the assumption that recurring funding levels could be reduced if aid availability goals were lowered. Since the purpose of the visual aids to navigation system is to mitigate marine transportation system transit risks, it doesn't seem prudent to manage funding levels by manipulating aid availability goals. The efficiency by which the USCG corrects ATON discrepancies directly impacts aid availability, so lowering aid availability goals would suggest that the Coast Guard should reduce its efficiency.

Furthermore, being less proficient at periodic maintenance or ATON discrepancy response would likely result in a much greater expense when the discrepancy is eventually corrected. For example, costs associated with lighted buoy inspection and maintenance typically include:

- operating expenses and personnel costs for the primary service delivery unit,
- procurement costs for replacing sections of the buoy's mooring system and other equipment required for the buoy.

If, in a cost savings measure, the maintenance isn't performed as scheduled, the buoy's mooring chain could break, leaving the buoy adrift. The resulting additional costs include:

- recovering the buoy,
- replacing the buoy and its entire mooring system and outfit (lantern, power system, etc.).

In addition, timely response and correction of an ATON discrepancy could help prevent a much costlier incident, such as a vessel collision or grounding.

Calculating Aid Availability

Aid availability is calculated by subtracting the length of time that an aid is unable to perform its specified function (down time) from the length of time that it should be performing its specified function (total time), divided by the total time.

This can be used to measure an individual aid or a system of aids to navigation.

$$\text{Aid Availability} = \frac{(\text{Total Time} - \text{Down Time})}{\text{Total Time}} \text{ or } \frac{\text{Up Time}}{\text{Total Time}} \text{ or } \frac{\text{MTBF}}{(\text{MTBF} + \text{MTTR})}$$

MTBF = Mean Time Between Failure
MTTR = Mean Time to Repair

Myth—Aid availability provides an accurate assessment of an ATON service delivery unit's efficiency. This myth equates a falling or raising aid availability with the efficiency of an ATON service delivery unit. While a service delivery unit's efficiency could certainly impact aid availability, there are a variety of other factors that could have a greater influence. Consider the following scenarios:

Scenario 1 – A vessel runs over a single-pile wooden lighted beacon, severing the pile below the seabed. The responding aids to navigation team deploys to investigate and determines that restoring it to its intended purpose requires a marine construction pile-driving effort. The team then searches the area for wreckage and deploys a temporary lighted buoy on the missing lighted beacon's assigned position.

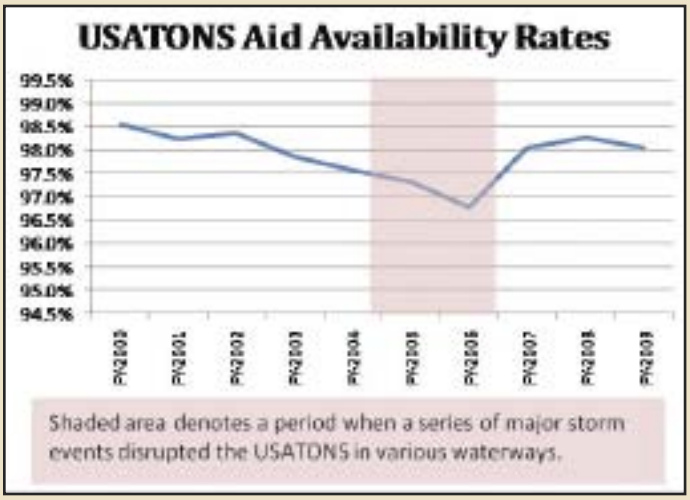
The result: The aids to navigation team has performed its mission per USCG policy, but has not reduced the discrepancy's impact on aid availability.

Scenario 2 – A storm has buffeted a coastal area for several days. On the first day of the storm, ATON servic-

The annual recurring funding for establishing, maintaining, and operating the U.S. visual aids to navigation system is approximately $300 million. Ninety percent of that goes towards personnel, ATON servicing platform operations and maintenance, and indirect support costs.

The remaining $30 million finances everything that either produces or supports an ATON signal (repair, maintenance, and replacement costs of buoys; buoy mooring systems; beacon structure components; optics; power systems; and day signals).

This funding level has been static over the past 10 years, with slight adjustments for consumer price index considerations. During that period, aid availability fluctuated by as much as 1.28% in one year. In the years of low aid availability (2005 and 2006), the ATON mission was allocated supplemental funding to reconstitute the visual aids to navigation system in those waterways disrupted by a series of major hurricanes.



A temporary lighted buoy marks the wreckage of a lighted beacon, which was damaged after a vessel allision.

A collapsed lighted beacon in Semiahoo Bay, Wash.

ing units were notified of several "priority" discrepancies.[2] However, the sea conditions preclude the aids to navigation team from deploying to investigate. Therefore, it may be several days after receiving the report before the team is able to respond. Aid availability suffers, but it is not caused by the ATON service delivery unit's inefficiency.

Myth—Unscheduled maintenance of ATON service delivery platforms or emergency diversion to other mission areas impacts aid availability. The USCG's ATON multi-tiered maintenance strategy provides reserve capacity, including primary and secondary service delivery units, for these and other contingencies.

During the *Deepwater Horizon* response, the USCG deployed half the seagoing buoy tender fleet and a quarter of the coastal buoy tender fleet to assist with oil cleanup efforts. As of October 2010, the majority of these assets had been deployed in support of this effort for over four months. During that time, short-term aid availability remained nearly constant at 98.52 percent.[3]

Short-term absences, such as unscheduled maintenance, seem to be adequately absorbed by multi-tiered maintenance strategy, with two exceptions:

- When short-term absences of ATON service delivery platforms correspond with a major waterway disruption, such as a major weather event, where a considerable surge operation is necessary to reconstitute the aids in the affected waterways.
- When the unscheduled maintenance of certain specialized ATON service delivery platforms results in the loss of that capability for an extended period. For example, inland construction tenders in the 5th, 7th, and 8th USCG districts repair or rebuild an average of 2,450 beacons annually, which is beyond the capability of other service delivery platforms.

Myth—Aid availability is primarily impacted by ATON component reliability. This assumes that an increase in ATON component failures (power systems,

Aid Availability History

The concept of aid availability became a topic of international interest in the mid-1970s when significant numbers of lighthouses were being automated. The Coast Guard implemented aid availability as a performance measure in the 1990s and established an overall strategic aid availability goal of 99.7 percent.

Since waterways have a variety of traffic patterns and risk levels, the Coast Guard assigned each of its aids to navigation to one of three categories based on the critical nature of the aid, the type and volume of marine traffic, the waterway configuration, and environmental considerations.

- Category 1: Vital navigational significance – aid availability goal = 99.8 percent.
- Category 2: Important navigational significance – aid availability goal = 99 percent.
- Category 3: Necessary navigational significance – aid availability goal = 97 percent.

Certain anomalies, such as major weather events, can have a short-term negative impact on aid availability. The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recommends tracking aid availability for three continuous years to accurately determine trends.

IALA also recommends that the minimum aid availability for any aid should not fall below 95 percent and that consideration should be given to discontinuing or replacing aids to navigation that consistently fall below that threshold.[1]

[1] IALA Recommendation O-130, Edition 1, Dec. 2004.

Fiscal Year	Percent of Discrepancies Caused by Component Failure	Annual Aid Availability Rate
2001	50%	98%
2006	17%	96.8%

The percentage or discrepancies attributed to component failure reached a 10-year high at 50 percent in 2001, but the annual aid availability that year was higher than the 10-year average at 98.3 percent. Conversely, when the annual aid availability fell to 96.8 percent in 2006 (the lowest 10-year level), component failures only accounted for 17 percent of all discrepancies.

USCG *Sledge* crew recovers wreckage and rebuilds an aid. USCG photo by Mr. Robert Trainor.

optics, buoys, mooring chain, dayboards, etc.) has a direct impact on the aid availability rate. However, an analysis of discrepancy data over the past 10 years does not support this assumption.

While component failures certainly influence discrepancy rates and may influence aid availability, the data does not support a direct correlation (see above example).

The Continuing Mission

To appropriately focus their resources, waterway managers must carefully measure the state of the aids to navigation systems under their purview. Aid availability rate is just one of the tools they use.

We must be mindful, however, to consider this information in perspective and in conjunction with other metrics to accurately assess overall waterway ATON health and effectiveness.

About the author:

Mr. Robert Trainor is an aids to navigation specialist in the Marine Transportation Systems Management Directorate, Visual Navigation Division at U.S. Coast Guard headquarters. He previously spent more than 30 years on active duty military service in the USCG, and his duty assignments included tours as commanding officer of two buoy tenders as well as numerous other aids to navigation positions.

Endnotes:

1. Aid availability is defined in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Aids to Navigation Manual as "… the probability that an aid to navigation or system is performing its specified function at any randomly chosen time."
2. One of five USCG ATON discrepancy response levels.
3. Four-month average: June through September 2010.

Another day aboard USCGC *Hammer*, rebuilding a damaged range light.

The "Black Hull" Fleet

Multi-function assets for multi-mission duty.

by CDR Gregory Tlapa
Chief, U.S. Coast Guard Visual Navigation Division

Black, White, Red

While all Coast Guard afloat assets are multi-mission platforms, they are loosely grouped into three communities—the black hull fleet, white hull fleet, and red hull fleet. As the names suggest, the hulls are painted those colors and denote each asset's primary mission function:

- Black hull—aids to navigation,
- White hull—maritime law enforcement and other safety-at-sea missions,
- Red hull—icebreaking.

"Primary" being the operative word: As Coast Guard missions have expanded and evolved, so have the capabilities of its assets. Today the terms serve more to describe the personnel aboard the assets, engendering camaraderie within the communities and spurring friendly competition among them.

To fulfill its multi-mission duties, the Coast Guard's black hull fleet or "buoy tenders" don't just tend buoys—these vessels are routinely employed in all of the Coast Guard's statutory mission areas, and carry specialized equipment to fulfill those functions.

For example, as a result of the *Exxon Valdez* oil spill in 1989, the Oil Pollution Act of 1990 mandated that they be outfitted with an onboard spilled oil recovery system (SORS) comprised of outriggers, booms, hydraulic skimming equipment, and product storage vessels.

In addition to "normal" operational training, seagoing buoy tender crews participate in annual training and mock exercises with this equipment. While the smaller coastal buoy tenders are not outfitted with SORS equipment, they also conduct annual training and mock exercises using pre-staged vessel of opportunity skimming system gear, and all crews receive hazardous waste operations and emergency response training.

Thanks to such training and exercises, these crews quickly integrated into the response to the sinking of

the mobile offshore drilling unit *Deepwater Horizon* in the Gulf of Mexico.

Cutters Deployed
In the largest environmental response mobilization of its buoy tender fleet, the Coast Guard deployed eight of its 16 seagoing buoy tenders (WLBs) and four of 14 coastal buoy tenders (WLMs) to this effort, comprising nearly half of the Coast Guard's heavy-lift capability for aids to navigation operations.

While this incident is, as of this writing, still undergoing investigation and review, we can share some of the black hull fleet's operational successes and lessons learned.

The Black Hulls

Multi-mission Assets

In addition to aids to navigation missions, these cutters are also deployed for:

- **Drug Interdiction.** March 2009, in the largest marijuana seizure by a USCG buoy tender, CGC *Aspen* intercepted a "go-fast" vessel loaded with eight tons of marijuana.
- **Fisheries Enforcement.** May 2009, CGC *Hickory* issued a major fisheries violation in the Nearshore Bristol Bay Trawl Closure Area.
- **Homeland Security.** September 2009, CGC *Osage* conducted on-scene waterborne security for the G-20 Summit.
- **Humanitarian Response.** January 18, 2010, CGC *Oak* was the first military ship to moor in Port-Au-Prince, Haiti, for earthquake response.
- **Environmental Response.** Mass mobilization of the buoy tender fleet to the 2010 *Deepwater Horizon* oil spill.

Early Lessons
The WLBs and WLMs deployed to the Gulf from nearly every Coast Guard district and coordinated with air assets to identify, track, and pursue oil patches and rule out areas that had no oil.

As with any unprecedented mission, field commanders refined tactics and procedures to improve efficiency. Recognizing the speed-distance-time limitations of surface assets and making calculated risk-based decisions for daily force deployment became a skill set unto itself—one that was routinely complicated by weather, ocean currents, and competing operational demands.

For example, initial operations employed a towed storage vessel or "sea slug" to contain recovered oily water. True to its name, this vessel contributed to sluggish cutter maneuverability and transit speed. Crews then employed onboard storage tanks, which were less cumbersome to deploy and tend, but also had limited capacity. As the response continued to evolve, mission commanders eventually deployed dedicated alongside tank barges, which increased recovered oil storage capacity and on-scene oil skimming time.

Maintenance and Decontamination
Shore-based vessel support and skimmer equipment repair teams drawn from Coast Guard headquarters, naval engineering support units, and strike force commands deployed to key Gulf ports and augmented cutter personnel during logistics stops and maintenance periods. Decontamination activities to conform to the Clean Water Act and other environmental and operational standards were ongoing at the time of this writing.

The Continuing ATON Mission
As the response in the Gulf continued beyond projected timelines, senior Coast Guard leaders were concerned that the absence of the buoy tenders would negatively impact the overall aids to navigation (ATON) infrastructure. In the end, however, the nationwide aid availability rate remained nearly constant throughout the deployment, which poses the question: *How can this be?*

Through a series of strategic initiatives and efficiency improvements over the last decade, the ATON program has dramatically improved hardware reliability and reduced the cutter resource hours needed to maintain the system.

Improvements in Efficiency and Technology
For example, seagoing buoy tenders have methodically transitioned from primary use as dedicated aids to navigation platforms to multi-mission assets. In the past, nearly 60 percent of their operational hours were devoted to performing ATON. In fiscal year 2009, however, these vessels spent only 39 percent of their operating hours on these duties, with the remaining 61 percent dispersed across other mission areas.

The coastal buoy tenders have experienced similar effects in mission employment, and expanded shore-based aids to navigation teams have also greatly improved overall mission response.

Additionally, though the buoys and beacons along the U.S. coast look much the same as they did 30 years ago, there has also been a systematic transformation of aids to navigation equipment and hardware and efficiency improvements including:

- differential GPS positioning,
- increased use of solar power,
- transition from incandescent lighting systems to light-emitting diodes,
- use of self-contained systems,
- new buoy coating systems.

While many of these initiatives may have gone unnoticed by the shipping industry and boating public, the result is greatly improved Coast Guard operational efficiency.

Furthermore, the Coast Guard employs a multi-tiered management philosophy to maintain ATON infrastructure so that each aid and waterway can be serviced by several types of Coast Guard assets. This means that a channel may be marked with large ocean and coastal buoys maintained by a coastal or seagoing buoy tender, while an aids to navigation team maintains the waterway's smaller buoys, ranges, and fixed aids.

Left Watching Properly

While the Coast Guard's aid availability rate remained constant despite a nearly four-month absence of half the seagoing buoy tender fleet, it is uncertain how much longer we could have maintained an acceptable rate.

There were contingency plans in place for discrepancies that could not be corrected by the shore-based aids to navigation teams while the primary servicing unit (the buoy tender) was absent, but it was expected that some discrepancies would take longer to correct.

Additionally, while short-term absences can be absorbed, the combination of the continued unavailability of a large portion of the buoy tender fleet *and* a major event such as a hurricane could have resulted in a mass failure of a particular waterway or ATON system.

Fortunately this did not occur, and Coast Guard personnel were able to keep the ATON infrastructure watching properly during this unprecedented deployment.

About the author:
CDR Tlapa is a graduate of the Coast Guard Academy, holds a master's degree in civil engineering from the University of Illinois, and is a registered professional engineer in the state of Alaska. His operational assignments include deck watch officer aboard USCG cutter Acacia, *executive officer of USCG cutters,* Red Beech *and* Cypress, *and commanding officer of USCGC* Hickory. *He is currently chief of the Visual Navigation Division at Coast Guard headquarters.*

CGC *Juniper*'s spilled oil recovery system.

U.S. Coast Guard maritime safety and security team divers climb aboard Coastal Buoy Tender *Abbie Burgess.*

The "Black Hull" Fleet

Seagoing Buoy Tenders

COMMISSIONED: 1996-2004

Juniper (WLB 201)
Willow (WLB 202)
Kukui (WLB 203)
Elm (WLB 204)
Walnut (WLB 205)
Spar (WLB 206)
Maple (WLB 207)
Aspen (WLB 208)
Sycamore (WLB 209)
Cypress (WLB 210)
Oak (WLB 211)
Hickory (WLB 212)
Fir (WLB 213)
Hollyhock (WLB 214)
Sequoia (WLB 215)
Alder (WLB 216)

Coastal Buoy Tenders

COMMISSIONED: 1996-2000

Ida Lewis (WLM 551)
Katherine Walker (WLM 552)
Abbie Burgess (WLM 553)
Marcus Hanna (WLM 554)
James Rankin (WLM 555)
Joshua Appleby (WLM 556)
Frank Drew (WLM 557)
Anthony Petit (WLM 558)
Barbara Mabrity (WLM 559)
William Tate (WLM 560)
Harry Claiborne (WLM 561)
Maria Bray (WLM 562)
Henry Blake (WLM 563)
George Cobb (WLM 564)

Icebreaking Tugs

COMMISSIONED: 1978-1987

Katmai Bay (WTGB 101)
Bristol Bay (WTGB 102)
Mobile Bay (WTGB 103)
Biscayne Bay (WTGB 104)
Neah Bay (WTGB 105)
Morro Bay (WTGB 106)
Penobscot Bay (WTGB 107)
Thunder Bay (WTGB 108)
Sturgeon Bay (WTGB 109)

CGC *Katmai Bay* breaks ice to service an extinguished ice buoy.

Inland Construction Tenders

160-foot Inland Construction Tenders

COMMISSIONED: 1976

Pamlico (WLIC 800)
Hudson (WLIC 801)
Kennebec (WLIC 802)
Saginaw (WLIC 803)

100-foot Inland Construction Tender

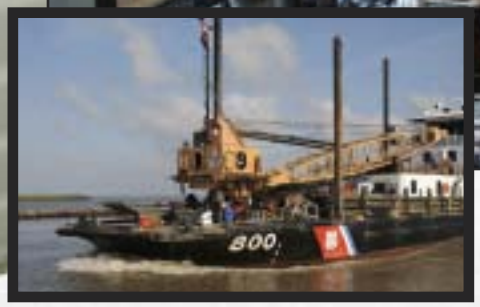
COMMISSIONED: 1944

Smilax (WLIC 315)

75-foot Inland Construction Tenders

COMMISSIONED: 1962-1965

Anvil (WLIC 75301)
Hammer (WLIC 75302)
Sledge (WLIC 75303)
Mallet (WLIC 75304)
Vise (WLIC 75305)
Clamp (WLIC 75306)
Hatchet (WLIC 75309)
Axe (WLIC 75310)



DHS Secretary Janet Napolitano observes aids to navigation operations aboard the Inland Construction Tender *Anvil*.

The Inland Buoy Tender, Coast Guard Cutter *Bayberry,* enforces a safety zone while the U.S. Navy "Blue Angels" perform at Seattle's 2003 Seafair.

Inland Buoy Tenders

100-foot Inland Buoy Tenders

COMMISSIONED: 1944
Bluebell (WLI 313)
COMMISSIONED: 1963
Buckthorn (WLI 642)

65-foot Inland Buoy Tenders

COMMISSIONED: 1954
Bayberry (WLI 65400)
Elderberry (WLI 65401)

River Buoy Tenders

75-foot River Buoy Tenders

COMMISSIONED: 1964-1970
Gasconade (WLR 75401)
Muskingum (WLR 75402)
Wyaconda (WLR 75403)
Chippewa (WLR 75404)
Cheyenne (WLR 75405)
Kickapoo (WLR 75406)
Kanawha (WLR 75407)
Patoka (WLR 75408)
Chena (WLR 75409)
Wedge (WLR 75307)
COMMISSIONED: 1990
Kankakee (WLR 75500)
Greenbrier (WLR 75501)

65-foot River Buoy Tenders

COMMISSIONED: 1960-1962
Ouachita (WLR 65501)
Cimarron (WLR 65502)
Obion (WLR 65503)
Scioto (WLR 65504)
Osage (WLR 65505)
Sangamon (WLR 65506)

Petty Officer Jesse Biggers pilots CGC *Kanawha*'s small work skiff.

Small Harbor Tugs

COMMISSIONED: 1962-1967

Capstan (WYTL 65601)
Chock (WYTL 65602)
Tackle (WYTL 65604)
Bridle (WYTL 65607)
Pendant (WYTL 65608)
Shackle (WYTL 65609)
Hawser (WYTL 65610)
Line (WYTL 65611)
Wire (WYTL 65612)
Bollard (WYTL 65614)
Cleat (WYTL 65615)

AN AGING FLEET

Although the design life of these cutters is typically 30 years, the average cutter in the black hull fleet is 32 years old.

Petty Officer Marc Snyder takes the helm of the Small Harbor Tug *Capstan* during an ice breaking evolution in the northern Chesapeake Bay.

How Narrow is "Narrow"?

NAVSAC recommends the Coast Guard develop navigation criteria.

by Mr. Craig H. Allen, Sr.
Judson Falknor Professor of Law and of Marine Affairs
University of Washington

In June 2010, the U.S. Navigation Safety Advisory Council (NAVSAC), the Coast Guard's advisory council on the Rules of the Road, unanimously recommended to the Coast Guard that it formally designate those waters in the U.S. that will be subject to Inland Navigation Rule 9 as "narrow channels or fairways." [1]

History

The NAVSAC action comes partly in response to a recommendation by the U.S. National Transportation Safety Board (NTSB) to the Coast Guard following the NTSB's investigation into a collision between two towing vessels on an inland waterway. The NTSB discovered that the vessel operators had come to conflicting conclusions as to whether the waters were a "narrow channel or fairway" for purposes of applying Rule 9.

The NTSB observed that it does "operators little good to learn months after an accident that a court has ruled that a particular portion of a waterway, under a particular set of circumstances, was or was not a 'narrow channel' under the rules, and that the narrow channel rule should or should not have been applied by the parties involved in the accident."[2] The board recommended that the Coast Guard publish guidance to enable operators to determine when to apply the narrow channel rule.

The Commandant of the Coast Guard agreed with the NTSB in part, but responded that "[to] define a 'narrow channel' so as to apply to all situations would be virtually impossible. It is possible, however, that the factors to be considered in determining when to apply the rule can be bounded and broad guidance issued to mariners." [3] After consideration by the Towing Safety Advisory Committee and the Rules of the Road Advisory Council in the early 1980s, the matter was tabled for nearly three decades.

In the spring of 2009, the issue resurfaced before the Navigation Safety Advisory Council following waterway designations by several local Coast Guard commanders.

Whose Authority?

For example, the Coast Guard's captain of the port (COTP) for San Francisco designated the entire San Francisco Bay Region as a "Regulated Navigation Area." The following provision was included in the regulations: "The master, pilot, or person directing the movement of a vessel within the Regulated Navigation Areas defined in paragraph (c) of this regulation shall comply with Rule 9 of the Inland Navigation Rules ... ." The Coast Guard captains of the port for Los Angeles/Long Beach and San Diego later made similar determinations for certain waters within their respective jurisdictions, and at least one Coast Guard command on the Atlantic coast expressed an interest in designating narrow channels.

These designations raised questions regarding the Coast Guard's policy and authority on narrow channel designations. Once this issue was raised, the Coast Guard asked NAVSAC to determine if there is a need to designate waters and waterways as narrow channels or fairways and, if so, to identify the criteria to be used in making the designations.

Rule 9 Working Group

To address this, NAVSAC formed the Rule 9 Working Group, which met in June of 2009 and again in June of 2010 to examine the issues and present draft recommendations to the council for consideration.

The working group members noted that the Inland Navigation Rules include two "area-based" risk management rules:

- Rule 9, applicable to waters that constitute narrow channels or fairways,
- Rule 10, applicable to traffic separation schemes.

The members also observed the contrast between Rule 9, which leaves it to the mariners to determine when the rule applies, and Rule 10, which applies only when the waters have been designated a traffic separation scheme. They also noted that the rules do not define "narrow channel" or "fairway" or provide the mariner with criteria for determining which waterways fall within those terms.

RULE 9
Narrow Channels

(a) (i) A vessel proceeding along the course of a narrow channel or fairway shall keep as near to the outer limit of the channel or fairway which lies on her starboard side as is safe and practicable.

(ii) Notwithstanding paragraph (a)(i) and Rule 14(a), a power-driven vessel operating in narrow channels or fairways on the Great Lakes, Western Rivers, or waters specified by the Secretary, and proceeding downbound with a following current shall have the right-of-way over an upbound vessel, shall propose the manner and place of passage, and shall initiate the maneuvering signals prescribed by Rule 34(a)(i), as appropriate. The vessel proceeding upbound against the current shall hold as necessary to permit safe passing.

(b) A vessel of less than 20 meters in length or a sailing vessel shall not impede the passage of a vessel that can safely navigate only within a narrow channel or fairway.

(c) A vessel engaged in fishing shall not impede the passage of any other vessel navigating within a narrow channel or fairway.

(d) A vessel shall not cross a narrow channel or fairway if such crossing impedes the passage of a vessel which can safely navigate only within that channel or fairway. The latter vessel shall use the danger signal prescribed in Rule 34(d) if in doubt as to the intention of the crossing vessel.

(e) (i) In a narrow channel or fairway when overtaking, the power-driven vessel intending to overtake another power-driven vessel shall indicate her intention by sounding the appropriate signal prescribed in Rule 34(c) and take steps to permit safe passing. The power-driven vessel being overtaken, if in agreement, shall sound the same signal and may, if specifically agreed to take steps to permit safe passing.

If in doubt she shall sound the danger signal prescribed in Rule 34(d).

(ii) This Rule does not relieve the overtaking vessel of her obligation under Rule 13.

(f) A vessel nearing a bend or an area of a narrow channel or fairway where other vessels may be obscured by an intervening obstruction shall navigate with particular alertness and caution and shall sound the appropriate signal prescribed in Rule 34(e).

(g) Every vessel shall, if the circumstances of the case admit, avoid anchoring in a narrow channel.

The group's conclusion: Rule 9 has the potential to be an important collision prevention rule, but its effectiveness is undermined, since it is often unclear to the mariner when the rule applies. The multi-factor Rule 9 analysis adopted by courts in collision cases is complicated, and the need for a case-by-case analysis of the relevant factors might well delay the mariners' collision avoidance action.

There is also a risk that two (or more) approaching vessels will reach conflicting conclusions as to whether Rule 9 applies to a given situation, as the tow boat operators did in the collision investigated by the NTSB. The working group therefore concurred with the NTSB recommendation to the extent that it recommended that the Coast Guard take action to better enable mariners to know when to apply the narrow channel rule.

Turning to the task presented by the Coast Guard, the working group unanimously concluded that the answer to the first question—should the Coast Guard designate narrow channels—is "yes."

Recommendation

To that end, the working group drafted a resolution to recommend that the Coast Guard exercise its authority to designate those waters and waterways that it determines are narrow channels or fairways.

However, rather than have the council compile a set of criteria for designating narrow channels or fairways throughout the nation's 25,000 miles of waterways, the working group recommended that a process for designation, and the criteria to be applied in those designa-

tions, be developed jointly by the Coast Guard headquarters staff, regional Coast Guard districts, and local Coast Guard sector commanders, in conjunction with relevant federal, state, and public stakeholders.

NAVSAC unanimously adopted this resolution and recommended that the Commandant prepare appropriate directives to the Coast Guard district and sector commanders as well as guidance documents for other concerned stakeholders that will set out the process by which the criteria will be developed and the designations will be made.

Recognizing that designation of Rule 9 waters and waterways would be an ongoing process, the council further recommended that the Coast Guard make it clear in designating Rule 9 waters and waterways that the list of designated waters and waterways is not all-inclusive.

Navigation Safety Advisory Council recommendations are not binding on the U.S. Coast Guard, but there is every reason to believe that the Coast Guard's national program managers will act on this resolution and give the green light to its district and sector commanders to begin the process for waters under their jurisdiction.

About the author:
Mr. Craig H. Allen Sr. is the Judson Falknor Professor of Law and of Marine Affairs at the University of Washington. He has served on NAVSAC since 2005. The views expressed are, however, the author's alone and do not necessarily represent those of the other members of NAVSAC or of the U.S. Coast Guard.

Champion's Note: The Coast Guard agrees that designating certain channels or waterways as "narrow channels" for the purposes of Rule 9 could enhance navigation safety. Formal guidance from the Navigation Standards Division will be forthcoming to begin the process of formally designating those waters subject to the Inland Navigation Rules that will be subject to Rule 9 as "narrow channels or fairways."

Endnotes:

1. At present, the resolution is limited to those waters that are subject to the inland navigation rules—those subject to local "special rules" authorized by COLREGS Rule1(b). It does not address the application of Rule 9 to those U.S. waters governed by the 1972 COLREGS.
2. National Transportation Safety Board (NTSB), "Collision of the U.S. Towboat M/V *Bruce Brown* and Tow with the U.S. Towboat M/V *Fort Dearborn* and Tow, Mile 677.6, Ohio River, Dec. 9, 1981, Report NTSB-MAR-82-5 (Jun. 17, 1982)" (NTSB Recommendation M-82-32).
3. USCG response to National Transportation Safety Board Safety Recommendations M-82-32 through 34, June 30, 1982.

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Offshore Renewable Energy Installations

Impact on navigation and marine safety.

by Mr. George H. Detweiler, Jr.
Marine Transportation Specialist
U.S. Coast Guard Marine Transportation Systems Management Directorate

To reduce our dependence on foreign energy supplies, alternative or renewable energy sources are being pursued. These sources exploit a wide range of technologies:

- solar photovoltaics or power plants;
- hydroelectricity (dams);
- ocean thermal energy conversion facilities;
- offshore renewable energy installations, which may include "wind farms," marine current turbines, and wave generators (hydrokinectics).

All these technologies have the potential to affect marine navigation and safety, and although no offshore renewable energy installations presently exist in U.S. waters, several are contemplated following successful trials in other countries. Of the technologies being considered, wind farms and hydrokinetics pique the Coast Guard's interest because their developers propose to locate them in U.S. navigable waters.

Navigation Impact
All offshore installations, regardless of type, will have impact on vessel navigation and safety in their vicinity.

Glossary of Terms

Wind Farm
A wind farm is a group of interconnected wind turbines used to produce electric power and is typically located off-shore to take advantage of strong winds blowing over the surface of an ocean or lake. A wind farm may consist of a few dozen to several hundred individual wind turbines, and can cover an extended area of 100 square nautical miles or more. In good meteorological conditions, they are readily identifiable visually and by radar.

Turbines
A wind farm's turbines are comprised of three parts:

- a foundation below sea level,
- a transition section with a platform,
- a nacelle: a structure that houses the generator.

Turbine blades are located opposite the nacelle. Typical modern wind turbines are approximately 400 feet above the surface, have blade diameters 130 to 300 feet, and are rated between 500 kW and 7 MW.

Wave Energy Converter
A wave energy converter is a device that extracts energy directly from the surface motion of ocean waves or from pressure fluctuations below the surface.

Tidal Energy Converter
Tidal energy converters are submerged water turbines that can extract energy from ocean currents. These turbines have rotor blades, a generator for converting the rotational energy into electricity, and a means of transporting the electrical current to shore.

Location. An offshore site could affect navigation based on the traffic volume, types of waterway users (deep draft or shallow draft vessels, high-speed craft, ferries), vessel sizes (length, width, height, draft, tonnage), and other vessel characteristics including speed capability, navigation equipment, and number of passengers.

In addition, an installation could affect non-transit uses of the area such as recreational fishing and day cruising, racing, marine regattas and parades, and aggregate dredging. Lastly, an offshore installation located near shipping lanes or in proximity to anchorage grounds or areas, safe havens, port approaches, and pilot boarding or landing areas could adversely impact vessels transiting in such locations.

Spacing. To make best use of the wind, turbine spacing is proportional to rotor size and the down-wind wake effect created. As such, wind farm turbines are generally spaced 500 meters or more apart.

Hydrokinetic projects such as wave generators or "buoy farms" are being contemplated as pilot projects, which will be limited in size and output. Footprint size will be small and may involve between four to 10 buoys, spaced much more closely than wind farm turbines.

Obviously both can limit or prevent vessel access within the installation, can create additional collision risk, and could limit the ability of vessels to maneuver and avoid collisions with the structures or with other vessels operating near them.

Visibility. These structures could also block or hinder the view of other vessels, the coastline, or other navigational features such as aids to navigation, landmarks, or promontories used by mariners to navigate.

Electronic impact. Larger structures could produce radio interference with respect to any frequencies used for aviation, marine positioning, navigation, or communications, including automatic identification systems. In addition, structures could produce radar reflections, blind spots, shadow areas, or other adverse effects on shipboard marine radar, and could produce sonar interference affecting fishing, industrial, or military systems in the area.

The site might also produce acoustic noise or noise absorption or reflections, which could mask or interfere with sound signals from other vessels or aids to navigation. Lastly, the generators and seabed cabling might produce electro-magnetic fields affecting compasses and other navigation systems.

Effects of tides, tidal streams, currents, seabed changes. Current maritime traffic flows and operations in the area of an offshore renewable energy installation are affected by the depth of water in which the installation is situated at various states of the tide. For example, the installation could pose problems at high water that do not exist at low water conditions, and vice versa. In addition, maritime traffic flow and operations are affected by currents in the area in which an installation may be situated, and current direction or velocity could increase allision risk.

Additionally, the structures themselves could cause changes in the set and rate of the tidal stream or direction and rate of the currents. Also, structures in the tidal stream could produce siltation, deposition of sediment or scouring, and other suction or discharge aspects, which could affect navigable water depth.

Mitigating the Impact

While these offshore renewable energy installations have many potential benefits, it's important to recognize the equally potential negative effects mentioned and to devise plans to mitigate them. Typically this is determined during the environmental impact statement process.

Permitting Agencies

The "lead permitting agency" is that agency that will permit the offshore renewable energy installation and develop the environmental impact statement for the specific project. In general, agencies are determined by project type and location. Wind farms located on the outer continental shelf come under the permitting jurisdiction of the Bureau of Ocean Energy Management, Regulation, and Enforcement; otherwise the U.S. Army Corps of Engineers takes the lead.

For hydrokinetic projects, the lead permitting agency is the Federal Energy Regulatory Commission, and for ocean thermal energy conversion projects, it's the National Oceanic and Atmospheric Administration.

Navigational safety risk assessment. For example, an offshore renewable energy installation developer should perform a systematic assessment of the risks to navigation safety associated with the proposed project and its location using the Coast Guard's risk-based decision making guidelines or other suitable industry standards.

For more INFORMATION:

The U.S. Coast Guard's Risk-Based Decision-Making Guidelines

http://www.uscg.mil/hq/cg5/cg5211/E-Guidelines.asp

The International Association of Marine Aids to Navigation and Lighthouse Authorities marking guidelines

http://www.orga.nl/index.php?page=231&l=en

It's important to identify any impact on navigational safety and assess the increase in risk associated as well as identify and evaluate potential measures that could be implemented to mitigate the increased risks.

The Coast Guard will review the assessment to develop a "safety of navigation" opinion and associated mitigation measures that it will forward to the appropriate lead permitting agency.

Navigational marking. The International Association of Marine Aids to Navigation and Lighthouse Authorities has promulgated recommendations on how to mark different types of offshore renewable energy installations, that they can be conspicuous under different meteorological conditions and during day and night. These recommendations include marking the installation perimeter with lights, marking an individual apparatus with alpha-numeric characters, and use of radar beacons, automatic identification system transceivers, and sound signals.

Charting and marine information. Proper charting (with proper chart nomenclature by a recognized hydrographic office) for offshore installations and their associated cabling is necessary to aid the mariner in transiting in or near these installations. Promulgation should also include notices to mariners, coast pilots, and notices in maritime publications.

Limited access areas and routing measures. It may be necessary to create limited access areas (safety zones, security zones, and regulated navigation areas) in and around an offshore installation to protect the mariner and the developer's property. Other routing measures such as an "area to be avoided," precautionary areas, or traffic separation schemes also may be utilized.

Technology improvement. As the offshore renewable energy installation industry matures, technological advances in equipment design, fabrication, and materials may reduce the impact on shipboard electronic equipment. Other mitigation measures may include modifications to reduce radar cross-section and telemetry from wind farms to radar, for example, as well as modifications to the shipboard radars themselves.

On the Horizon

Alternative or renewable energy is already here in the United States. Wind farms dot the landscape and are being proposed for offshore locations. Developers are working diligently to create hydrokinetic devices to harness water power from our rivers and along our coasts.

Although offshore installations may present new challenges to safe navigation in U.S. waters, proper preparation, a complete voyage plan taking into account all relevant information, and proper adherence to the applicable navigation rules should ensure safe passage for a vessel as well as its crew.

About the author:
Mr. George H. Detweiler, Jr., retired from the U.S. Coast Guard after more than 20 years of service. He is currently a marine transportation specialist in the Marine Transportation Systems Management Directorate at USCG headquarters. His major projects have included conducting port access route studies, creating ships' routing measures, reviewing offshore renewable energy installation proposals, and conducting tribal consultations.

Bibliography:
Maritime and Coast Guard Agency Marine Guidance "Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs" and "Offshore Renewable Energy Installations (OREIs): Guidance on UK Navigational Practice, Safety, and Emergency Response Issues."

Collaborating to Mitigate Risk

The tools that guide the process.

by LCDR Tony Maffia
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Mr. George H. Detweiler, Jr.
Marine Transportation Specialist
U.S. Coast Guard Marine Transportation Systems Management Directorate

Mr. Burt Lahn
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U.S. Coast Guard Marine Transportation Systems Management Directorate

The United States Coast Guard Office of Marine Transportation Systems Management develops and implements policies and procedures that facilitate commerce, improve safety and efficiency, and inspire dialogue within the maritime community to make our waterways safe, efficient, and commercially viable. One way we do this is by establishing risk baselines that guide our decisions. Three tools that guide these efforts:

- ports and waterways safety assessments,
- waterways analysis and management system studies,
- port access route studies.

Ports and Waterways Safety Assessments
The Coast Guard established the ports and waterways safety assessment (or PAWSA) process to address waterway user needs and place a greater emphasis on partnerships with industry. The process involves convening a group of waterway users and stakeholders and conducting a structured workshop to elicit their opinions.

The primary objectives:

- improve coordination and cooperation between government and the private sector by involving stakeholders in decisions affecting them;
- develop and strengthen harbor safety committees;
- support Coast Guard responsibilities in waterways management and environmental stewardship;
- provide input for projects related to aids to navigation, regulations, or other risk mitigation measures, including potential vessel traffic management projects.

PAWSA workshops can establish a baseline of waterways for vessel traffic system consideration and allow the local host—typically a sector commander or marine safety unit commanding officer—to interact with the local waterway community to evaluate risk and work toward long-term solutions tailored to local circumstances.

The USCG has conducted dozens of formal PAWSA workshops, and the process represents a significant part of joint public-private sector risk mitigation planning. The Coast Guard uses this input to establish or relocate aids to navigation, adjust VTS reporting requirements, and implement regulatory changes.

Waterway Analysis and Management System Study
Our nation's waterways contain more than 100,000 aids to navigation—the buoys and beacons that provide visual, electronic, and audible signals to maritime transportation system users. A waterway analysis and management system study helps Coast Guard water-

continued on page 24

Recent PAWSA Success Stories

Electronic charting system. In 2009 PAWSA workshops for Houston-Galveston and Honolulu, Hawaii featured an electronic charting system that replaced paper navigational charts used during previous workshops. This allowed workshop facilitators to more effectively communicate statistical information, including plotting the locations of vessels involved in marine casualties (collisions, allisions, and groundings), providing a clear depiction of "trouble spots" in a waterway. This system is now in effect for all PAWSA workshops.

Electronic charting system images allow PAWSA workshop facilitators to more effectively communicate statistical information. USCG graphic.

ATON awareness. In 2010, a Savannah, Ga., PAWSA workshop focused on assessing the aids to navigation (ATON) infrastructure in the Savannah River and its approaches. Workshop participants reviewed individual segments of the waterway in detail as they answered a series of questions about the usefulness, location, and functionality of the ATON system. Their input will form the basis of future aids to navigation configuration in the waterway.

way managers review and improve the ATON system in a particular waterway.

For more INFORMATION:

PAWSA
http://www.navcen.uscg.gov/?pageName=pawsaMain

PARS
(202) 372-1566

WAMS
(202) 372-1547

U.S. Coast Guard Navigation Center website:
http://www.navcen.uscg.gov

The system study evaluates the aids to determine their effectiveness, which can lead to altering technical aspects of an aid, establishing new aids, or removing ineffective aids. Most important: The study incorporates the perspectives of major and/or frequent waterway users to identify the most effective aid mix while anticipating needs for the future demands of a particular waterway.

Port Access Route Studies

Our ports support a tremendous amount of activity. Cargo vessels arrive each day in American ports and may travel from port to port; commercial and recreational fishermen transit ports on their way to and from fishing grounds; other recreational and commercial vessels add to the traffic. Permanent structures such as oil rigs and offshore renewable energy installations may affect port traffic, and areas like designated marine sanctuaries also must fit into this mix.

To manage this, the Coast Guard may designate or adjust necessary fairways and create traffic separation schemes to provide safe access routes. Through the port access route study process, the Coast Guard consults with affected Native American tribes as well as federal, state, and foreign state agencies (as appropriate) and considers the views of maritime community representatives, environmental groups, and other interested stakeholders.

The objectives:

- determine present and potential traffic densities,
- evaluate existing vessel routing measures,
- justify new vessel routing measures and their type,
- determine any mandatory vessel routing measures for specific classes of vessels.

This process helps to ensure, to the extent practicable, that the need for safe access routes is reconciled with other reasonable waterway uses. In addition to aiding the Coast Guard to establish new fairways or adjust existing ones, the process may be used to determine and justify safety zones, security zones, recommended routes and other routing measures, and to create regulated navigation areas.

Port access route studies continue to identify critical changes in maritime traffic volumes or routes, and allow the Coast Guard to implement sound vessel routing measures to ensure safe passage in the off-shore approaches to our nation's ports and harbors.

About the authors:
LCDR Tony Maffia is currently stationed in the Marine Transportation Systems Management Directorate Visual Navigation Division at U.S. Coast Guard headquarters. He has 14 years of Coast Guard experience, including seven years of sea time on four Coast Guard cutters—including two tours as executive officer and an 11-month deployment in support of Operations Iraqi and Enduring Freedom in 2003. He enlisted in the U.S. Coast Guard in 1997 and is a 2000 graduate of Officer Candidate School.

Mr. George H. Detweiler, Jr., retired from the U.S. Coast Guard after more than 20 years of service. He is currently a marine transportation specialist in the Marine Transportation Systems Management Directorate at USCG headquarters. His major projects have included conducting port access route studies, creating ships' routing measures, reviewing offshore renewable energy installation proposals, and conducting tribal consultations.

Mr. Burt Lahn is a marine transportation specialist in the Office of Navigation Systems, serving as a project officer within that office since 2002 and as the PAWSA program manager since 2008. Mr. Lahn is a retired USCG lieutenant commander, having completed 24 years of active duty service. With over 20 years of service in the Coast Guard's marine safety program, he has extensive experience in vessel inspections, marine casualty investigations, and oil and hazardous materials response operations.

Improving the Marine Event Permit Program

by LCDR Ellis H. Moose
Marine Event Permit Program Manager
U.S. Coast Guard Office of Marine Transportation Systems
Oceans and Transportation Policy Division

While the Coast Guard has been safely and successfully administering the marine event permit program for years, the ambiguity of existing policy has made it difficult to provide a consistent service-wide approach.

Currently, Coast Guard district and sector commanders evaluate the need for an event permit by using locally developed risk-based decision making and knowledge of their areas of responsibility. While this practice has resulted in an impressive safety record, it's created inconsistencies in how the program is administered from unit to unit and district to district.

These inconsistencies make it difficult to administer a national program and can, in some cases, set precedents that may be inappropriate in other areas of the country. Recently several districts have drafted standard operating procedures or other guidance to subordinate units to try to improve unit-to-unit consistency within the district. However, these new district instructions often vary dramatically from one district to another. Clearly the time is right for revised national policy to bring consistency to the program.

The Review

The Office of Marine Transportation Systems at Coast Guard headquarters owns the marine event permitting process and is working with Training Center Petaluma, whose analysts are developing a strategic needs assessment, a five-phase process that consists of:

- performance analysis,
- root cause analysis,
- intervention selection,
- implementation,
- evaluation.

Coast Guard members navigate their canoe during a race against the other four branches of the military at the 68th annual Walter MacFarlane Canoe Regatta held in Waikiki on July 4, 2010. U.S. Coast Guard photo by Petty Officer 3rd Class Michael De Nyse.

Coast Guardsmen and Pittsburgh River Rescue Unit members stand by to assist an entry in the "Anything that Floats" race, which is a part of the annual Pittsburgh Three Rivers Regatta. U.S. Coast Guard photo by PA1 Megan Casey.

The project is currently in phase one, in which analysts define the "optimal state," identify the current state of the program, delineate the differences (or "gap") between the two, and outline possible steps to close the gap. Solutions will certainly include revisions to national policy but could also include job aids, detailed work instructions, or training courses.

The Process

Throughout the summer and fall of 2010, the analysts from Training Center Petaluma visited Coast Guard units throughout the country to review data on the current state, including local standard operating procedures, environmental review checklists, patrol commander handbooks, samples of completed unit review packets, process flow charts, training slideshows, etc. They then solicited opinions on the optimal state. Not surprisingly, this process revealed a variety of related concerns with the program that must be accounted for in the optimal state.

Once analysts identify the gaps, the next steps will be to conduct a root cause analysis and develop an intervention strategy to close them. The intent is to complete the analysis before the end of 2011 and draft a corresponding rewrite of Commandant Instruction 16751.3, which provides guidelines for district commanders to delegate and exercise effective control over regattas and marine parades.

Seamless Service Delivery

While the strategic needs assessment process continues, Coast Guard units must continue to execute the

Marine Event Permit Strategic Needs Assessment

At the start of the needs assessment, Training Center Petaluma analysts asked the following core questions:

1. What events require permits?
2. What are the time frames involved?
3. How do you conduct environmental site assessments and national environmental policy act assessments?
4. Who evaluates the permit application?
5. What training do they receive?
6. What policies/procedures are in place to support this process? Federal, state, local?
7. What other activities or processes impact the permitting process?
8. What are some of the barriers you encounter during the process?
9. What sorts of things (policies, procedures, training, etc.) do you think would improve the process?
10. If the event is approved, what happens then?
11. What would cause a permit to be denied?
12. What qualifications do marine event permit evaluators/processors need?

The results will be analyzed to develop appropriate follow-on action.

program using the risk-based approach that has served so faithfully to date. Furthermore, it's important to recognize that sector and district commanders will always have wide latitude to exercise discretion in the administration of the program regardless of the outcomes from this project.

Seaman Apprentice Jonathan Stilp of Station Marblehead observes July 4th fireworks while on patrol in Sandusky Bay, Ohio. U.S. Coast Guard photo.

No national policy will ever substitute for considering the totality of the situation, the inherent risks associated with gathering people and vessels on the water, and the local issues unique to an area when exercising this authority. It is the goal of this project to foster a policy that provides a consistent approach while continuing to provide effective control over marine events.

About the author:
LCDR Moose is a graduate of the U.S. Merchant Marine Academy and currently assigned to the U.S. Coast Guard Office of Marine Transportation Systems. His marine safety experience includes port safety and security, waterways management activities, and qualification as a senior marine inspector and marine investigator. He holds a master's degree in marine affairs from the University of Washington.

A U.S. Coast Guard rescue boat from Coast Guard Station Sandy Hook, N.J., patrols the East River near the Macy's July 4th fireworks barges. USCG photo by PA2 Tom Sperduto.

Abandoned and Derelict Vessel Removal

Understanding the process can ensure success.

by LCDR Charles Bright
U.S. Coast Guard Office of Marine Transportation Systems

Abandoned and derelict vessels can be seen in most ports and communities as one drives across rivers or while out boating and fishing on the waterways. These vessels are unsightly, threaten safe navigation, and can pose environmental hazards.

The Problem

Vessels are abandoned or become derelict for many reasons. Some owners simply don't take care of their boats and let them fall into disrepair. Other vessels are stolen or taken for "joyrides" and then set adrift or discarded. Hurricanes or tornadoes can damage vessels and even move them from anchorage.

The recent economic downturn has also played a role. A 2009 New York Times article documented that a growing number of people are abandoning their boats because they can't afford the payments.[1]

A derelict vessel is dismantled on a bank of the Snohomish River in Everett, Wash. U.S. Coast Guard photo by Chief Petty Officer Paul Roszkowski.

Coast Guard Chief Petty Officer Ian A. Woods, left, Sector New York, and Petty Officer 3rd Class Huynh A. Nguyen, Sector Mobile, oversee hazardous materials remediation and vessel recovery in Bayou La Batre, Ala. U.S. Coast Guard photo by PA2 Lisa Hennings.

Unfortunately, these vessels can number in the hundreds in some locations, such as states with large boating publics like Florida, Georgia, and Washington. In some of these locations, vessels have been abandoned for such a long time that no one can remember how they got there or who the owners are.

Who Has the Lead?

If the owner cannot be found or is unable to remove the vessel, many times removal will fall to the federal or state government. Along with state environmental and enforcement agencies, four federal agencies play a role in abandoned and derelict vessel removal:

- the National Oceanic and Atmospheric Administration,
- the U.S. Army Corps of Engineers,
- the U.S. Coast Guard,
- the Federal Emergency Management Agency.

Even with the multitude of authorities, limited funding and resources can pose a problem.

Best Practices

To address this, in September 2009 the National Oceanic and Atmospheric Administration hosted the first Federal Abandoned and Derelict Vessel Workshop, where the four federal agencies presented their processes for dealing with vessels to the state agencies. In addition, several state program managers presented best practices for dealing with the numerous vessels within their states.[2]

For example, the Washington State Department of Natural Resources funds vessel removal primarily through an additional fee on state vessel registration. This fund provides up to 90 percent of the removal and disposal costs. The department also carefully prioritizes derelict vessels to determine which present the greatest threat to navigation, safety, and the environment.[3]

The Florida Fish and Wildlife Conservation Commission may remove vessels that are considered derelict under state regulations.[4] The vessel owner is contacted and a notice is posted on the vessel identifying it as a

derelict vessel. The owner has five days to remove the vessel. If the owner doesn't take any action, he or she can be charged with a first-degree misdemeanor and may also be charged for the cost of removing the vessel.

Coordinating Efforts

Understanding all the authorities and jurisdictions is just the beginning when it comes to dealing with the problem of abandoned and derelict vessels. With the multitude of state and local programs and federal authorities, coordinating this process can be a daunting task. Federal and state agencies and local or private groups should come together prior to any incident to establish working relationships.

Knowing where one agency's authority and funding stops and another begins facilitates this process. For example, the Coast Guard may use its funds to remove oil or hazardous material from the vessel. From there, the Army Corps or a state agency may take over to remove the vessel from the water. Once removed, the vessel has to be salvaged for its remains or

For more INFORMATION:

For additional information on abandoned and derelict vessels or questions regarding a specific vessel or situation, contact the local Coast Guard sector via **www.Homeport.mil,** the local Army Corps District Office at **www.USACE.army.mil,** or the NOAA Marine Debris Program at **http://marinedebris.noaa.gov/.**

Which Agency Does What?

The National Oceanic and Atmospheric Administration

NOAA responds to abandoned and derelict vessels through the National Marine Sanctuaries Act when a vessel is within or threatens resources within a sanctuary.

NOAA additionally supports activities in the marine environment by funding grant opportunities such as those focused on vessel removal and providing technical assistance through the Marine Debris Research, Prevention, and Reduction Act of 2006, which applies to all waters.

NOAA's personnel may provide scientific and technical assistance to a federal on-scene coordinator, when requested.

The United States Army Corps of Engineers

USACE is involved with abandoned and derelict vessels when a vessel sinks in or impacts a navigable channel. It may conduct a channel survey to determine whether the vessel constitutes an obstruction to navigation.

The location of the vessel with respect to the navigation channel will determine whether further USACE involvement in removal is warranted, per internal guidelines and available funding.

The United States Coast Guard

The USCG is involved with abandoned and derelict vessels by its designation as the federal on-scene coordinator to oversee federal response efforts for the containment, removal, and disposal of oil or hazardous substance releases into the marine environment.

The vessel may be removed as part of the abatement process or could be transferred to another agency for final disposal.

The Coast Guard also has authority to remove abandoned barges of greater than 100 gross tons under the Abandoned Barge Act. Under this act, the Coast Guard can remove the vessel if the cost of removal does not exceed its value.

Prior to removal, the Coast Guard may also mark vessels if they present a hazard to navigation.

The Federal Emergency Management Agency

FEMA is involved with abandoned and derelict vessels via the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), which gives FEMA the responsibility of coordinating the federal government's response to disasters.

FEMA may assign another federal agency to remove eligible vessels when the state and local governments certify that they lack the capability to perform or contract for the work.

Additionally, FEMA may reimburse applicants for the cost of vessel removal and disposal through grant assistance.

A vessel is moved to Sparrows Point in Baltimore. U.S. Coast Guard photo.

moved to a proper disposal site such as a landfill. This process may again be handled by a state agency or by a private contractor.

Planning the process from beginning to end is key to avoiding roadblocks and other unwanted situations. No one wants a vessel removed only to find out there is no place to put it. It may also be that one agency (a state historical preservation office, for example) asserts itself in the operational review and approval process because the vessel might be considered a historical landmark. These types of situations do happen and can best be avoided through a fully coordinated plan.

About the author:
LCDR Charles Bright has served in the Coast Guard since 1991. He is a prior enlisted marine science technician and has served on a patrol boat, on an aids to navigation team, and in various marine safety positions including inspections, investigations, and waterways management. A recent graduate of the Coast Guard Transportation Management graduate program from George Mason University, he also holds a master's degree in environmental management from the University of Maryland University College.

Endnotes:

1. David Streitfeld, "Boats Too Costly to Keep Are Littering Coastlines," New York Times, March 31, 2009.
2. N. Parry and K. McElwee (eds.), 2010. Proceedings of the Workshop on State-level Responses to Abandoned and Derelict Vessels. September 15-17, 2009. NOAA Technical Memorandum NOS-OR&R-37.
3. Washington State Department of Natural Resources, Derelict Vessel Removal Program, http://www.dnr.wa.gov/RecreationEducation/Topics/DerelictVessels/Pages/aqr_derelict_vessel_removal_program.aspx.
4. Florida Fish and Wildlife Conservation Commission (FWC), "FAQs: Derelict Vessels,"http://myfwc.com/Newsroom/Resources/News_Resources_DerelictVessel.htm.

The San Francisco Bay Region's Harbor Safety Committee

Communication and collaboration fuel success.

by Ms. Joan Lundstrom
Chair, Harbor Safety Committee of the San Francisco Bay Region

In the wake of the recent catastrophic Gulf oil spill, the Harbor Safety Committee (HSC) of the San Francisco Bay Region is continuing its collaboration with the Coast Guard, the National Oceanic Atmospheric Administration (NOAA), the U.S. Army Corps of Engineers, and local stakeholders to enhance navigational safety and prevent maritime accidents and spills.

The Harbor Safety Committee of the San Francisco Bay Region's jurisdiction extends 100 miles from the San Francisco Lighted Horn Buoy 12 miles offshore to the inland Ports of Sacramento and Stockton. USCG photo by PO Kevin J. Neff.

At monthly meetings, the 20-member committee hears reports from its work groups and the Coast Guard, NOAA, the Corps of Engineers, and the California Office of Spill Prevention and Response. Typically 40 to 50 members of the public attend to hear and discuss what's happening in the harbor.

By encouraging open communication in a town hall-like atmosphere, the HSC of the San Francisco Bay Region has gained a reputation as an active forum for the maritime community and state and federal agencies to work together to address current and emerging safety issues.

As CAPT Paul Gugg, recently retired captain of the port (COTP), Sector San Francisco noted: "In the Bay Area, the Coast Guard sees the HSC as a truly representative cross-section of its customer base."

The San Francisco-Oakland Bay Bridge can be completely shrouded in fog. Photo courtesy of the San Francisco Bay Conservation and Development Commission.

RESPONDING TO CHALLENGES

AIS Dock Identification System

In 2005 the HSC navigation work group labored to develop a dock and berth numbering scheme based on the United Nations local codes to be used to indicate AIS locations. This was a significant undertaking, since many of the berths in the region had been identified solely by owner/operator names.

Working with the Coast Guard vessel traffic service (VTS) staff, the stakeholders in the region numbered every current and future dock in a logical and consistent manner. Though there was some initial reluctance to move away from the legacy dock and berth names, the VTS and community became more comfortable using the new identification scheme, and it has become the standard and the model for other regions.

Near-Miss in Dense Fog

Subsequently, during an HSC meeting, a ferry captain reported a near-miss of two commuter ferries in dense fog at the ferry building. The ferry operations work group began public discussions to develop an agreed-upon navigation protocol. The four commuter ferry companies/agencies agreed to work together under the leadership of then-CDR Pauline Cook, who led the local Coast Guard VTS, the regional Water Transit Authority, and maritime stakeholders.

The work group analyzed and developed an approach and maneuvering scheme for the congested ferry building approach and departure area, as well as a routing protocol in the central Bay, to decrease the risk of collision for commuter ferries.

Scott Humphrey, training director of Sector San Francisco VTS, provided the key analysis of ferry patterns, which led all parties to agree upon recommended changes. The routing protocol consists of planned routes and communications procedures that reduce crowding around the ferry building, which is critical in dense fog conditions.

In 2008 the committee formally adopted the routing protocols, which NOAA then incorporated into nautical charts. With ferry routes now charted, other types of vessels, including recreational boats, can more easily predict the locations of the fast ferries and steer clear.

For more INFORMATION:

The marine exchange of the San Francisco Bay Region has established a website, **www.SFMX.org,** that includes harbor safety committee meeting agendas, minutes, the harbor safety plan, and electronic copies of informational brochures and links to other pertinent websites.

Container Ship Struck Bay Bridge

Another challenge arose in November 2007 when the container ship *Cosco Busan* struck the Bay Bridge in dense fog. Within days of the spill, Governor Arnold Schwarzenegger directed the Office of Spill Prevention and Response to investigate the causes and response to the allision. The office called upon the harbor safety committee to analyze the navigational safety-related issues of the governor's directive and make appropriate recommendations regarding prevention.[1]

Over the next year the HSC responded to the governor's directive and worked further to adopt "best maritime practice" guidelines for large vessels, tugs with tows, and commuter ferries operating in fog and severe weather conditions. The practices identify critical maneuvering areas and are incorporated into the U.S. *Coast Pilot*, the Coast Guard VTS manual, the San Francisco bar pilots manual, and the harbor safety plan.

CAPT Gugg observed: "Through the HSC process, pilot, vessel and port operators, and regulatory agency concerns were aired and consensus on solutions was reached before recommendations of the many formal incident reviews were even released."

U.S. Coast Guard photo.

Loss of Propulsion Incidents from Mandated Low-Sulfur Fuel

In 2009 another maritime challenge arose when Coast Guard Sector San Francisco and the bar pilots alerted the harbor safety committee of a dramatic increase in total loss of propulsion of ships following implementation of the California Air Resources Board (ARB) low-sulfur fuel switching requirement.

The Coast Guard documented increased incidents of engine failure, including a tanker in distress just west of the Golden Gate Bridge, which stopped 15 feet from the rocky Marin Headlands. Bar pilots reported vessels not responding to low-speed engine orders or failing to start.

The HSC chair contacted the ARB staff to meet with the maritime community to discuss the unintended consequences of the regulation. In a public meeting of more than 70 California and Pacific Coast maritime representatives with the head of the ARB regulatory department and a staff attorney, mariners reported leaking fuel systems due to the lighter fuel, concern about boiler safety, complex fuel switching procedures, and possible long-term deterioration of fuel pumps and engines not designed for low-sulfur fuel.

As a result of the meeting, the California Air Resources Board agreed to actively promulgate safety exemption provisions to mariners, work with the Coast Guard on outreach, and report monthly to the harbor safety committee on waivers. The HSC further requested the board to convene a technical work group to analyze short-term and long-term vessel operational issues and possible engine deterioration.

The ARB then contracted with the California Maritime Academy to analyze root causes of the propulsion failures based on Coast Guard incident reports and bar pilots' anecdotal information. A California Air Resources Board technical meeting was held in April 2010 to report findings and lessons learned.

The Coast Guard and the HSC continue to monitor propulsion failures in the San Francisco Bay region. While the number of ships experiencing problems associated with fuel switching is down, it is essential to determine where low-sulfur fuel results in a loss of propulsion, determine the cause, and vigorously communicate lessons learned.

U.S. Coast Guard photo.

Every day commercial ships transit in and out of San Francisco Bay. Photo courtesy of the San Francisco Bay Conservation and Development Commission.

About the author:
Joan Lundstrom is the chair and a charter member of the Harbor Safety Committee of the San Francisco Bay Region. In 2007 the committee was named Harbor Safety Committee of the Year. Ms. Lundstrom has received a Coast Guard Certificate of Merit and the Pacific Coast/BC Oil Spill Task Force Legacy Award.

Endnote:

1. Investigations concluded the allision was due to human error, not mechanical failure.

Pilotage

One of the oldest yet least-understood maritime professions.

by Captain Michael R. Watson
President
American Pilots' Association

The Pilot

State-licensed compulsory pilots are experts in all navigational aspects of a local port or waterway who temporarily go aboard vessels to guide them into and out of port. This is in contrast to individuals who may obtain a federal pilot endorsement or otherwise serve as a "pilot" while a member of a ship's crew.

Rear Admiral Brian M. Salerno, the Coast Guard's Deputy Commandant for Operations, described the work of a pilot as follows:

"Each day, pilots are asked to take all sizes and types of vessels through narrow channels in congested waters where one miscalculation could mean disaster. They are trained, highly professional individuals, whose judgments must be spot-on for the hundreds of decisions they must make at every turn to bring a vessel safely to its berth or out to sea."

Captain Stuart Lilly of the Biscayne Bay Pilots mans the conning station. All photos courtesy of APA.

Twelve-foot waves break over the small wheelhouse as the pilot boat makes its way toward the waiting 1,000-foot foreign flag container ship. When the pilot boat arrives alongside the ship, the state-licensed compulsory pilot steps out into the frigid night air and freshening 20-knot winds to evaluate how best to safely time her step from the pilot boat onto the pilot ladder and commence the several-story climb up the hull of the huge container ship. After carefully scaling the long rope ladder, she steps aboard the ship and proceeds to the bridge.

Once on the bridge, the pilot goes through an exchange of important information with the ship's master, which must be done carefully because the foreign master's first language is not English. During this two-way exchange, the pilot discusses with the master (who may never have been to this port) how she will navigate the ship in the approaches, through the channels, and to the pier. Among other matters, she informs the master of any relevant local port peculiarities or navigational nuances, as well as anticipated traffic. She asks the master if there is anything she should be aware

of regarding the ship's maneuverability or equipment and then surveys the ship's bridge team and equipment.

After this "master-pilot" exchange, the pilot assumes navigational control of the vessel and begins directing its movement by giving helm and engine commands. While the pilot has made this trip hundreds of times, this is no routine task, considering the ship is far wider than originally envisioned by the channel designers and the draft of more than 46 feet leaves little space between the hull and the bottom of the 47-foot dredged channel.

Scenarios like the one described unfold thousands of times each year as state-licensed pilots around the country use in-depth local knowledge, seasoned navigational and shiphandling expertise, and informed independent judgment to guide ocean-going foreign trade ships of all sizes and types into and out of the constricted and often shoaled channels of America's ports.

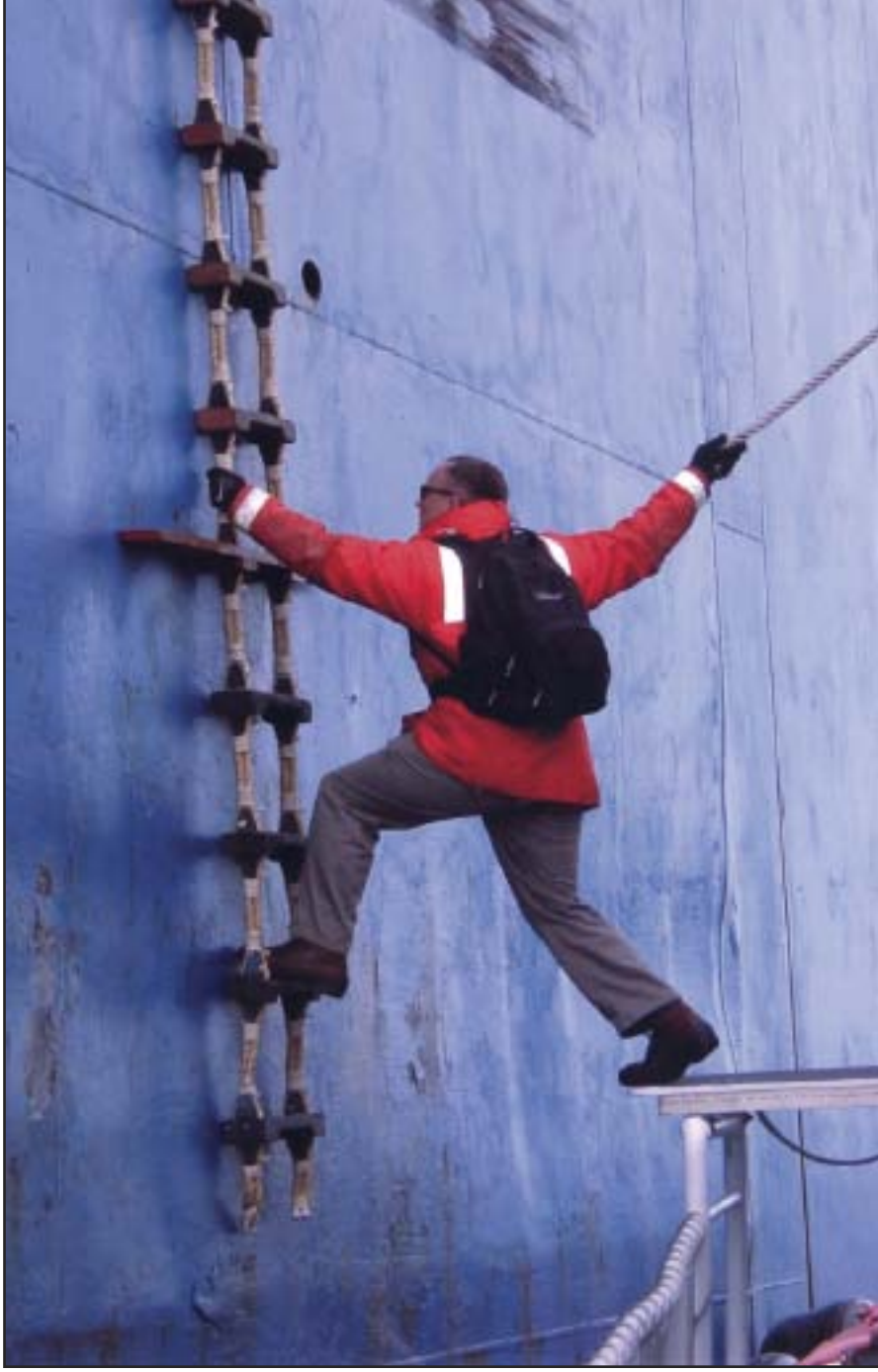
Shared Authority, Singular Purpose

Even though pilots are a critical component of safe and efficient maritime transportation of people and cargoes, and have been operating in port areas for hundreds of years, there still exists some confusion and misunderstanding regarding the role and function of pilots.

When a ship is in U.S. compulsory pilotage waters, responsibility for its safe navigation is shared between the pilot and the vessel master. A pilot, when aboard a ship and engaged in pilotage duties, directs the ship's navigation. The pilot's authority to direct the ship's movements is, however, subject to the master's overall command authority and responsibility for the ship's safety.

The pilot and master share a common purpose: Guiding the vessel safely to its berth or out to sea. The state-licensed pilot, whose primary responsibility is to protect the interests of the state that issues his or her license, is expected to act in the public interest and to exercise independent judgment to protect the property, lives, environment, and economic well-being of a port area.

Since the pilot is not a crewmember, he or she is insulated from the economic pressures on shipping interests, and directs the movement and navigation of the ship in a manner that protects the marine environment and maintains navigational safety while facilitating waterborne commerce.



Captain Morgan Hoburg, San Francisco Bar Pilots, steps from the pilot boat to the pilot ladder.

American Pilots' Association Guidance

It is not unusual in some segments of the maritime community to hear a pilot described as merely an "advisor" to the master. That description, in my opinion, is misleading and unfortunate and does not accurately capture what is expected of a state-licensed pilot. Additionally, this description is not consistent with principles of U.S. pilotage law; it is counter to mandates given to vessel masters under international regulations and doesn't reflect how a pilot carries out his or her duties on the bridge of a ship.[1]

It is important to the overall navigational safety of a vessel that the master, bridge team, and other vessel in-

terests have an understanding of—and respect for—the role and responsibilities of the pilot.

While not having the legal effect of case law, agency rulings, or regulations, the American Pilots' Association statement on the role and responsibilities of the pilot, developed in cooperation with the shipping community, summarizes the legal responsibilities and duties of the pilot and is a good reference in the event of any confusion or misunderstanding regarding the proper role of the pilot.

About the author:
Captain Michael R. Watson, a graduate of the U.S. Merchant Marine Academy, has been a pilot and leader in the piloting profession for more than 40 years. He was president of the Association of Maryland Pilots for 18 years and has been president of the American Pilots' Association since 2000. In 2006 he became the first American in over 30 years to be elected president of the International Maritime Pilots' Association (IMPA). He was re-elected IMPA president in 2010.

Endnote:

1. For more information, see *Ralli v. Troop*, 1 U.S. 386, 15 S. CT. 657 (1895); *The China*, 74 U.S. 53 (1868); IMO Assembly Resolution A.960(23) "Recommendations on Training and Certification and Operational Procedures for Maritime Pilots Other than Deep-Sea Pilots," adopted in 2003; IMO Seafarers' Training, Certification and Watchkeeping Code, as amended, section A-VIII/2, part 3-1; and Commandant Decision, May 14, 2001, Re: M/V *Skava*, 2001.

The Respective Roles and Responsibilities of the Pilot and the Master

Navigation of a ship in United States pilotage waters is a shared responsibility between the pilot and the master/bridge crew. The compulsory state pilot directs the navigation of the ship, subject to the master's overall command of the ship and the ultimate responsibility for its safety. The master has the right, and in fact the duty, to intervene or to displace the pilot in circumstances where the pilot is manifestly incompetent or incapacitated or the vessel is in immediate danger (in extremis) due to the pilot's actions. With that limited exception, international law requires the master and/or the officer in charge of the watch to cooperate closely with the pilot and maintain an accurate check on the ship's position and movement.

State-licensed pilots are expected to act in the public interest and to maintain a professional judgment that is independent of any desires that do not comport with the needs of maritime safety. In addition, licensing and regulatory authorities, state and federal, require compulsory pilots to take all reasonable actions to prevent ships under their navigational control from engaging in unsafe operations. Because of these duties, a compulsory state pilot is not a member of the bridge "team." Nevertheless, a pilot is expected to develop and maintain a cooperative, mutually supportive working relationship with the master and the bridge crew in recognition of the respective responsibility of each for safe navigation.

—Official APA statement

A small pilot boat from the Virginia Pilot Association makes its way to sea to transport a pilot to a merchant ship.

Domestic Icebreaking Operations

by LT Benjamin Morgan
Mobility and Ice Operations
U.S. Coast Guard Office of Maritime Transportation Systems

While domestic icebreaking operations may fall among the Coast Guard's less glamorous assignments, this mission is important for maritime mobility and supports our national transportation infrastructure.

Operations include establishing and maintaining tracks (paths through the ice) in connecting waterways during the winter navigation season, escorting vessels to ensure their transit is not impeded by ice, freeing vessels that become beset, clearing/relieving ice jams, removing obstructions or hazards to navigation, and advising mariners of current ice and waterways conditions.

This vital icebreaking mission is executed domestically by one heavy icebreaker, nine ice-breaking tugs, 11 small harbor tugs, and 12 ice-capable buoy-tending vessels.

International Icebreaking Cooperation
In addition to U.S. Coast Guard assets, the Canadian Coast Guard operates two icebreakers on the Great Lakes.

The USCG and Canadian Coast Guard keep each other advised on the location and status of icebreaking facilities/assets and coordinate operations to keep critical waterways open for commerce. A cooperative agreement between our two nations allows the assets from one country to conduct icebreaking operations in the territorial waters of the other, as necessary.

East Coast Icebreaking
Along the East Coast, icebreaking generally occurs to facilitate deliveries of home heating oil, critical supplies in isolated communities, and ferry services in its busiest ports.

During January and February, East Coast ports can receive more than 15 million tons of petroleum products, food, and other cargo.[1] Nearly 70 percent of the home heating oil in the U.S. is used in the Northeast, and 90 percent must travel by barge.[2]

Under typical winter conditions, icebreaking may only be needed in the freshwater or brackish rivers and tributaries. However, during more severe conditions, coastal waterways leading to Boston, New York, Portland, the Cape Cod Canal, and isolated communities dependent on ferry services such as Nantucket may also require substantial icebreaking efforts. These efforts also benefit commercial fishing fleets by providing access in and out of port.

On the Great Lakes
Throughout the Great Lakes region and the St. Lawrence Seaway, icebreaking activities are organized into two task groups:

Operation Taconite encompasses the waters of Lake Superior, Lake Michigan, the St. Mary's River system, the Straits of Mackinac, and northern Lake Huron. Ice-

breaking efforts in this region are coordinated from the vessel traffic service at Coast Guard Sector Sault Ste Marie, Mich.

Operation Coal Shovel is responsible for Lake Erie, the Detroit River, lower Lake Huron, Lake St. Clair, and the St. Clair River. This operation is jointly managed by U.S. and Canadian forces via USCG Sector Detroit and the Regional Ice Operations Center in Sarnia, Canada.

The Way Ahead

The Coast Guard's domestic icebreaking mission is at a critical juncture. As many icebreaking assets—specifically the 140- and 65-foot icebreaking tugs—are at or past their designed service life, the Coast Guard is initiating a project to extend the service life of the 140-foot icebreaking tugs. Additionally, performance analysts are investigating icebreaking resource allocations to ensure that cutters are placed in a position that best meets the needs of our diverse customers.

Another vital component of the continued success of the domestic icebreaking program is sustaining professional relationships with commercial industry stakeholders such as the Lake Carriers Association, tug/tow

Planned Domestic Icebreaking Center of Excellence

Operating any vessel in ice requires a unique set of skills and experience. The Coast Guard recognizes that these abilities are considerably more significant for icebreaking ship-handlers.

In response, Coast Guard senior leadership is crafting the vision for a "Domestic Icebreaking Center of Excellence," which will serve as a centralized training nucleus encompassing all subjects pertaining to icebreaking operations.

While focused and standardized training may be a primary function of the center of excellence, the icebreaking experts may also be responsible for managing icebreaking policies; defining performance metrics; updating and standardizing manuals, reports, and standard operating procedures; and promoting policy consistency among the three districts involved in icebreaking operations.

Further, analysis of data collected by the center could be used to maximize resource allocation, track icebreaking asset maintenance issues, and provide input for icebreaker service life extension projects or mission needs statements. Finally, the center may prove to be an important conduit for communications and outreach.

Coast Guard Cutters *Mackinaw* and *Neah Bay* break ice on Lake St. Clair during Operation Coal Shovel. U.S. Coast Guard photo by Ensign Guillermo Colom.

operators, commercial fishing fleets, ferry services, and the businesses that rely on year-round maritime transportation. Close cooperation with commercial icebreaking companies is also important, as there are many demands for icebreaking assistance on the Great Lakes that the Coast Guard simply cannot meet.

Working together, the Coast Guard will continue to meet the demands of commercial shipping, and prepare for successful operations well into the future.

About the author:
LT Benjamin Morgan has served in the U.S. Coast Guard for nine years, including tours aboard domestic and polar icebreakers and in waterways management.

Acknowledgments:
The author gratefully acknowledges the support of LCDR Brian Donahue, Ninth District Chief of Aids to Navigation and Icebreaking; CWO Jim Ziolkowski, Atlantic Area Waterways Management Analyst; and Mr. Matt Stuck, First District Chief of Aids to Navigation and Icebreaking.

Endnotes:

1. Jonathan Nickerson, Gordon Garrett, James Kearney, and Anita Rothblum, "United States Coast Guard Domestic Icebreaking Mission Analysis Report," U.S. Coast Guard Research and Development Center, New London, CT, May 2010.
2. First Coast Guard District Domestic Icebreaking Report, 2004.

Vessel Traffic Services as Information Managers

Improving how information is shared with stakeholders.

by CDR William Burns
Chief, Vessel Traffic Services Division
U.S. Coast Guard Office of Shore Forces

The capabilities and authorities of vessel traffic services uniquely position them as information managers among public and private maritime stakeholders. Initiatives such as maritime domain awareness and Department of Homeland Security interagency operations centers for maritime security in the United States (as well as other various efforts internationally) show the desire to grow and improve information sharing, particularly in addressing security concerns.

While some new processes inevitably will need to be developed, each vessel traffic service (VTS) has been collecting, interpreting, and sharing information for many years. The data a VTS collects varies due to different types of traffic and environment, but the overall information is fairly consistent. Vessel traffic services adopt processes for sharing this information to match the unique needs of maritime stakeholders.

There are currently 12 vessel traffic services in the United States. Though each is unique to its operating environment, all are alike in that they provide information services, navigation assistance services, and traffic organization services to enhance navigation safety and marine environmental protection. Mariners encounter a VTS in over two-thirds of the world's major ports, and VTS communications span the continuum of control from vessel monitoring to informing, recommending, and directing vessels to take appropriate action. In the U.S., vessel traffic services are delegated by federal regulations to discharge certain duties of the captain of the port (COTP) duties.

Incident Management

A vessel traffic service's 24/7 monitoring watch makes each vessel traffic center a natural communications hub for mariners and allied shore-based services. In fact, most initial reports to the

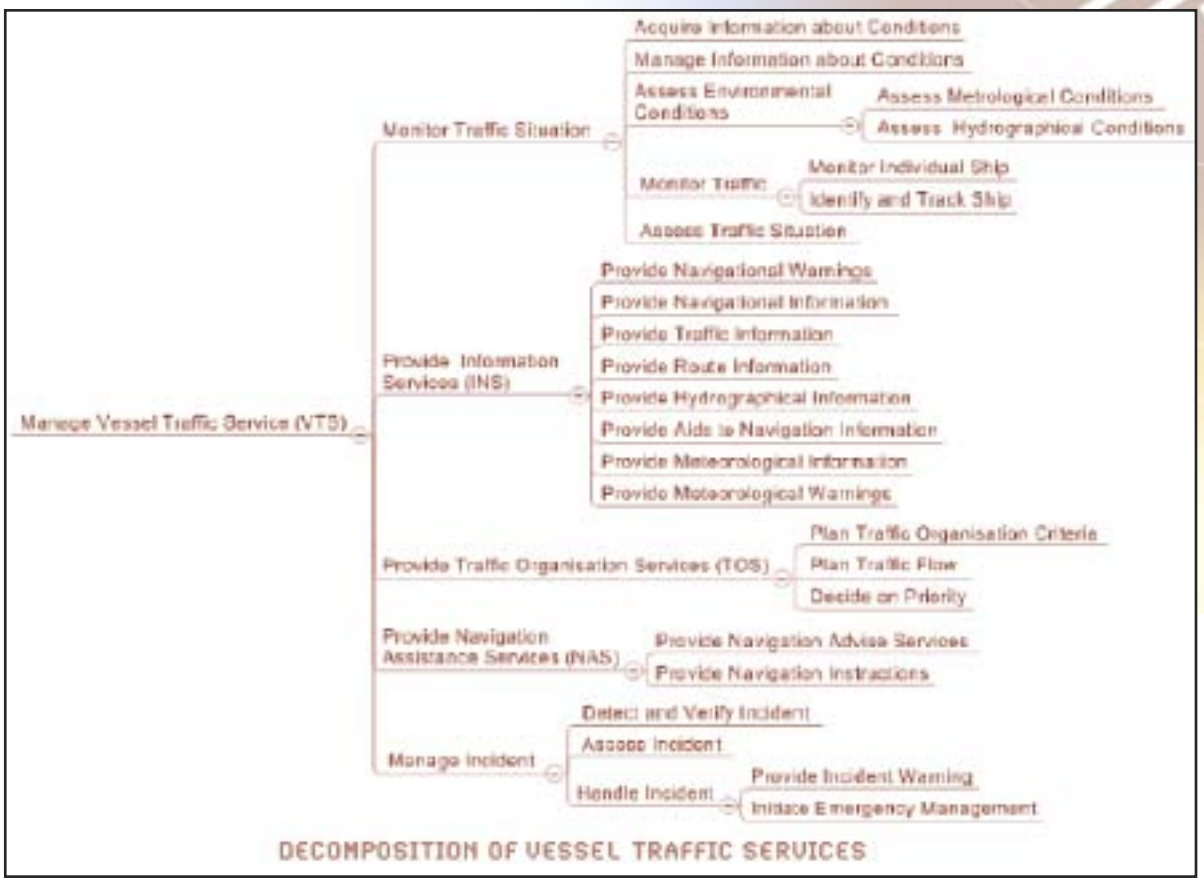
VTS in International Waters

The December 1979 Cooperative Vessel Traffic Service (CVTS) Agreement between the governments of the United States of America and Canada remains in force and has served as a prime example of international teamwork in maintaining seamless vessel exchanges from one VTS authority to another.

The agreement's area, which includes an internationally recognized traffic separation scheme, is divided among two Canadian centers in Victoria and Tofino, British Columbia, and one U.S. center in Seattle, Wash., that allows Canadian and U.S. authorities to manage traffic in each other's navigable waters.

Tracked vessel data is shared as the vessel crosses from one vessel traffic center's area of responsibility to another. Additionally, information containing all U.S. tracked vessel data is automatically sent from the Seattle vessel traffic center to a Canadian server, where it is combined with other tracked vessel data. This provides VTS Puget Sound and Canada's west coast marine communication and traffic services centers with a traffic image of all tracked vessels from Alaska to southern Puget Sound.

Coast Guard for incidents in a VTS area are made to a vessel traffic center watch person. Quick-response checklists and other mechanisms help ensure the response is consistent and coordinated, including the proper transfer of responsibility for incident management.



This breakdown of vessel traffic services succinctly summarizes the functions of a VTS that generally apply to all U.S. Coast Guard vessel traffic services. Graphic courtesy of IMO.

For example, Houston-Galveston, Port Arthur, and New Orleans each use a port coordination team that deals with port closures due to fog, storms, environmental incidents, or heightened maritime security. Membership includes representatives from every entity managing, servicing, carrying, or processing commerce along the respective waterways. Each team keeps the captain of the port informed on port infrastructure and operational needs and uses the VTS to manage the port coordination team center.

Following team activation, the focus shifts from initial response to developing a traffic management plan to restore commerce, which takes into consideration elements like feedstock levels within the petroleum refinery infrastructure, tug availability, pilot availability, and critical manufacturing components being imported or exported from the port, as well as normal traffic management issues. The coordination ultimately ensures the safe and secure restoration of port operations as it is incrementally reopened and eventually fully restored.

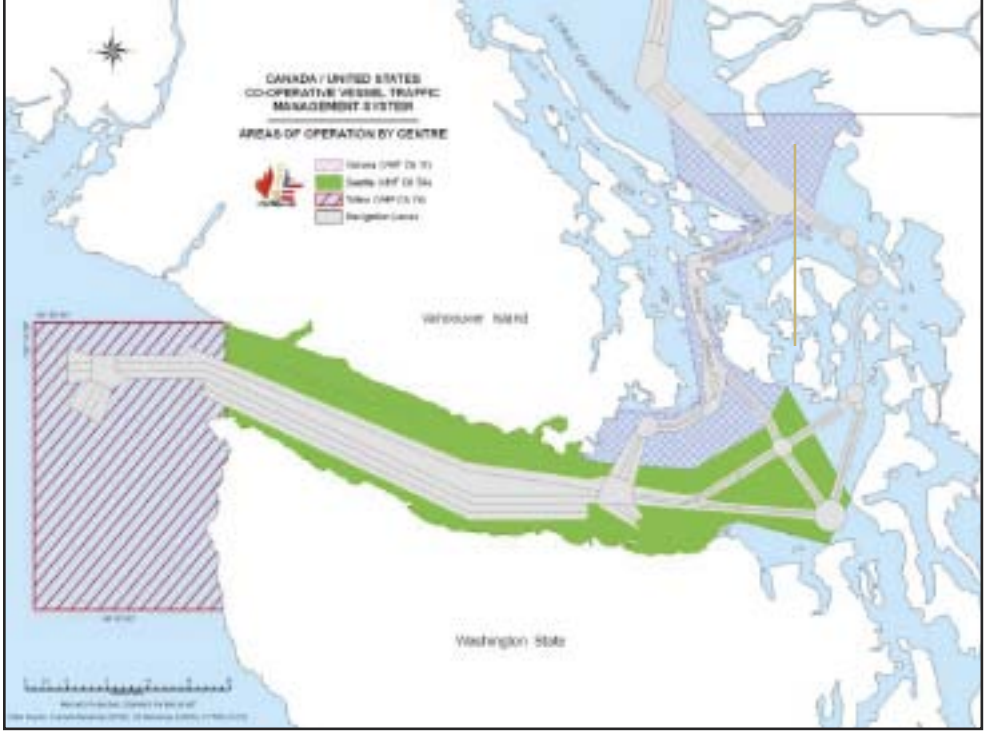
Public Outreach

Beyond the scope of a VTS's round-the-clock operational involvement with maritime users and services, VTS directors coordinate services with maritime stakeholders, many times through the local harbor safety committee, to improve traffic management and port infrastructure and protect the economic viability of local businesses.

Case in point: VTS San Franciso provided historical transit data for the 2009 Trans Bay cable project, which involved burying approximately 53 miles of cable beneath Suisan Bay, the Carquinez Straits, San Pablo Bay, and San Francisco Bay. This information was then factored into the project's impact analysis. The VTS also worked with the Harbor Safety Committee of the San Francisco Bay Region, Bay Area Rapid Transit, energy transmission companies, energy engineering companies, and other stakeholders to re-route the cableway from a prime anchorage area used during low visibility and facilitate early coordination for anchoring waivers and safety zones for the project's vessels.

Continuing Interaction

A VTS's influence extends well beyond the daily interactions with pilots and vessel masters. It includes all port partners and several not-so-obvious public and private maritime stakeholders, including lightering interests, tow companies, shipping agents, marine exchanges, oil refineries, terminals, carriers, harbor tugs,



Shown are the geographic boundaries of each of the traffic service centers included in the cooperative vessel traffic service (CVTS) for the Juan de Fuca Region. This is the only CVTS arrangement the U.S. is currently engaged in, but consideration is being given toward developing a similar agreement for the Great Lakes that would include VTS Saint Mary's River in Sault Ste. Marie, Mich. Graphic courtesy of the Canadian Coast Guard.

port authorities, railroads, the Army Corps of Engineers, the National Oceanographic and Atmospheric Administration, public utilities, maritime construction companies, and multi-modal transportation authorities.

Maintaining these bonds takes a dedicated and consistent effort. For VTS Puget Sound, it means at least quarterly meetings of the Joint Coordinating Group to ensure the proper maintenance of the Cooperative Vessel Traffic Services Agreement. For VTS St. Mary's River, it means coordination with the U.S. and Canadian managers of the St. Lawrence Seaway, as well as their Canadian counterparts at MCTS Sarnia and Thunder Bay.

For all vessel traffic services, it means meeting the maritime users through ship rides and facility visits, arranging maritime stakeholder VTS visits, and consistently and actively participating in local maritime committees.

About the author:
CDR William Burns has more than 14 years of experience in waterways management, serving aboard three buoy tenders and developing national and international policy and capabilities for the visual aids to navigation, radio aids to navigation, and vessel traffic services programs. He is currently serving as the VTS program manager and as the U.S. representative to the International Association of Marine Aids to Navigation and Lighthouse Authorities VTS Committee.

AIS Binary Messages

Since 2002, VTS Saint Mary's River in Sault Ste. Marie, Mich., has been broadcasting AIS binary messages from its VTS AIS base stations in a harmonized effort with the Saint Lawrence Seaway Development Corporation, the Saint Lawrence Seaway Management Cooperation, and the Lake Carriers' Association. The source data for these broadcasts are received from AIS-ATON transmission equipment installed aboard NOAA weather buoys or entered by vessel traffic service watch personnel.

The Ports and Waterways Safety System, which is VTS Saint Mary's River's traffic management system, then packages the data into messages[1] addressed to specific users or broadcast to all users and passes the messages to the VTS AIS base stations for transmission. Maritime users with equipment designed to interpret and display the messages receive river current, salinity, water temperature, and vessel procession order information that they use to safely navigate the waters connecting Lake Huron and Lake Superior.

The implementation of broadcasting binary messages is being further broadened across the U.S. to the remaining VTS ports equipped with PAWSS through the VTS AIS Transmit Project. Several years remain until full operational capability is achieved, but in the meantime the project test bed at VTS Tampa and the scheduled expansions to VTS Louisville and VTS Port Arthur are examining additional features of binary messages and developing the technical and administrative framework for managing them.

Endnote:
1. International Telecommunication Union Radiocommunication Sector Recommendation 1371, technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band.

Bibliography:
USCG Vessel Traffic Services National Standard Operating Procedures Manual

World Vessel Traffic Services Guide, http://www.worldvtsguide.org/

International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Vessel Traffic Services Manual, 2008

International Convention for the Safety of Life at Sea (SOLAS) Chapter V, Regulation 12

International Maritime Organization Assembly Resolution A.857(20)—*Guidelines on Vessel Traffic Services*

Agreement for a Cooperative Vessel Traffic Management System for the Juan de Fuca Region, dated December 19, 1979

St. Lawrence Seaway AIS Data Messaging Formats and Specifications, Revision 4.0A, May 9, 2002

International Telecommunication Union Radiocommunication Sector (ITU-R) Recommendation 1371—Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band

Trans Bay Cable homepage: http://www.transbaycable.com/

For more information on VTS, visit http:// www.navcen.uscg.gov.

Developing Navigation Standards

The IMO Subcommittee on Safety of Navigation.

by Mr. Edward J. LaRue, Jr.
Chief, Navigation Standards Division
U.S. Coast Guard Marine Transportation Systems Management Directorate

Shipping is perhaps the most international of the world's industries, serving more than 90 percent of global trade.[1] The ownership and management chain surrounding any ship can include many countries, and ships may spend their economic lives moving through different jurisdictions, often far from the country of registry.

There is, therefore, a need for international standards that can be adopted and accepted by all to regulate shipping. The first maritime treaties date back to the 19th century. Later, the *Titanic* disaster gave rise to the first international Safety of Life at Sea (SOLAS) convention, still the most important treaty addressing maritime safety.

The International Maritime Organization

The International Maritime Organization (IMO) is a specialized agency of the United Nations, based in the United Kingdom, with 169 member states and three associate members. The convention establishing IMO was adopted in Geneva in 1948, and it first met in 1959.

IMO's main task has been to develop and maintain a comprehensive regulatory framework for shipping. Its responsibility today includes safety, environmental concerns, legal matters, technical cooperation, maritime security, and shipping efficiency.

The organization consists of an assembly, a council, and five main committees:

- the Maritime Safety Committee,
- the Marine Environment Protection Committee,
- the Legal Committee,
- the Technical Co-operation Committee,
- the Facilitation Committee.

The Maritime Safety Committee is the highest technical body of the organization. It consists of all member states, and its functions are to consider any matter within the scope of the organization concerned with:

- aids to navigation,
- vessel construction and equipment,
- manning from a safety standpoint,
- rules to prevent collisions,
- handling dangerous cargoes,
- maritime safety procedures and requirements,
- hydrographic information,
- log books and navigational records,
- marine casualty investigations,
- salvage and rescue.

The NAV Subcommittee

Under the instructions of the Maritime Safety Committee and with input from the Marine Environmental Protection Committee, the Subcommittee on Safety of Navigation (NAV) considers matters related to obliga-

tions of governments and operational measures related to safety of navigation, including:

- hydrographic and meteorological services;
- ships' routing;
- ship reporting systems;
- aids to navigation;
- radio navigation systems;
- vessel traffic services and pilotage, including the role of such measures in the protection of the marine environment;
- carriage requirements;
- performance standards and operational guidelines for the use of shipborne navigational equipment and other navigational requirements, including bridge design, bridge visibility, and pilot transfer arrangements;
- operational requirements and guidelines relating to navigational safety and associated issues, such as regulations for the prevention of collisions and groundings, bridge procedures, voyage planning, avoidance of dangerous situations, places of refuge, and relevant aspects of maritime security.

The subcommittee is charged to develop any necessary amendments to relevant conventions and other instruments, as well as to prepare new instruments, guidelines, and recommendations for consideration by the committees.

Major Developments

At a typical session, the NAV will consider more than a dozen ship routing or reporting proposals. Many of them are quite complex and require careful examination to ensure they meet the criteria of the general provisions on ships' routing. Over the past three NAV sessions the subcommittee has taken action on a number of proposals.

Of particular interest to the U.S.: Amendments were approved to the existing traffic separation scheme in the approach to Boston, Mass., that moved ship traffic away from the preferred feeding grounds of the Northern Right Whale.

Areas to be avoided and mandatory "no anchoring" areas were approved for two offshore liquefied natural gas facilities off the northeast U.S. coast to caution mariners of their presence and provide a measure of protection for the facilities.

In other action: The subcommittee developed a safety of navigation circular providing information on the internationally recommended transit corridor for ships transiting the Gulf of Aden, which is intended to reduce the risk of acts of piracy against ships in the area.

The subcommittee also approved a draft circular on assuring safety during demonstrations, protests, or confrontations on the high seas to address, in particular, the interactions between environmentalists and whaling ships.

The NAV approved amendments to SOLAS V regulation 23 and assembly resolution A.889(21) to update the requirements relating to pilot transfer arrangements.

It also approved amendments to SOLAS V regulation 19 to reflect a new carriage requirement for a bridge navigational watch alarm system to monitor bridge activity and detect operator disability that might lead to marine casualties.

An additional amendment to SOLAS V regulation 19 was approved to establish a mandatory carriage requirement for the Electronic Chart Display and Information System (ECDIS), thus bringing the most advanced charting technology to ship bridges.

The subcommittee also approved a revised text of assembly resolution A.953(23), updating technical specifications of the worldwide radio navigation system.

Additionally, the NAV developed a safety of navigation circular on guidelines for bridge equipment and systems arrangement and integration to enhance ergonomics and interoperability on the bridge.

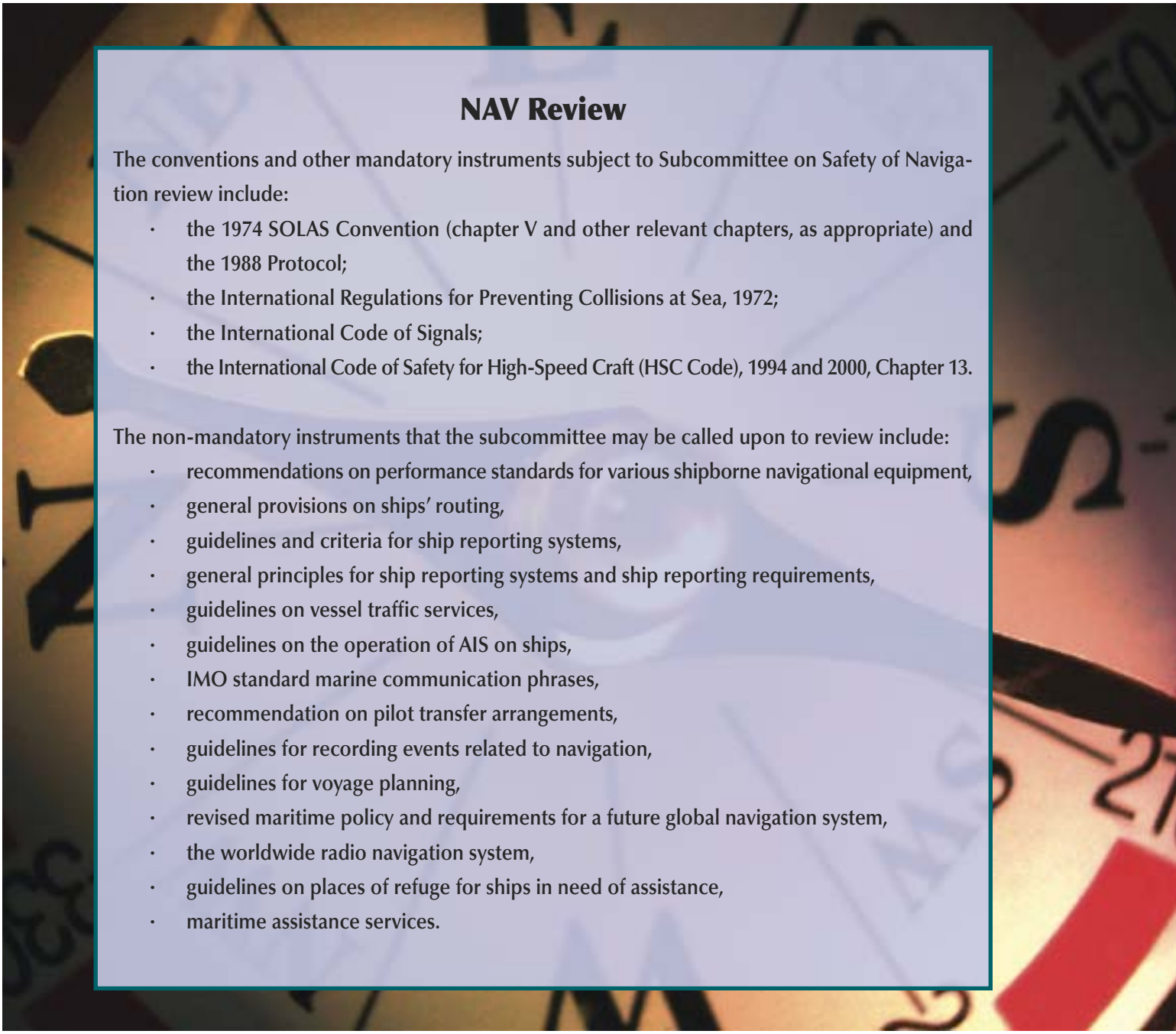
The subcommittee approved a safety of navigation circular on guidance for Automatic Information System application-specific messages information.

It prepared a draft Maritime Safety Committee resolution on performance standards for bridge alert management to categorize and prioritize onboard alarms so a particular failure may be more easily identified.

Looking Ahead

Since its first session in 1966, which was almost exclusively devoted to collision regulations, operational requirements of special types of craft, and requirements for fishing vessels, the NAV agenda has expanded dramatically.

Incremental advances in technology have driven this expansion over the years, but more recently computerization and the development of integrated bridge sys-



NAV Review

The conventions and other mandatory instruments subject to Subcommittee on Safety of Navigation review include:

- the 1974 SOLAS Convention (chapter V and other relevant chapters, as appropriate) and the 1988 Protocol;
- the International Regulations for Preventing Collisions at Sea, 1972;
- the International Code of Signals;
- the International Code of Safety for High-Speed Craft (HSC Code), 1994 and 2000, Chapter 13.

The non-mandatory instruments that the subcommittee may be called upon to review include:

- recommendations on performance standards for various shipborne navigational equipment,
- general provisions on ships' routing,
- guidelines and criteria for ship reporting systems,
- general principles for ship reporting systems and ship reporting requirements,
- guidelines on vessel traffic services,
- guidelines on the operation of AIS on ships,
- IMO standard marine communication phrases,
- recommendation on pilot transfer arrangements,
- guidelines for recording events related to navigation,
- guidelines for voyage planning,
- revised maritime policy and requirements for a future global navigation system,
- the worldwide radio navigation system,
- guidelines on places of refuge for ships in need of assistance,
- maritime assistance services.

tems have created a greater surge. For example, for decades radar was a stand-alone device. Now it is possible to have a display for radar, or ECDIS, or both, that also displays Automatic Information System information and records all the required data in the ship's voyage data recorder.

This, of course, requires all the performance and technical standards to be consistent so the various equipment and systems can properly interact to provide timely and accurate information to the mariner. As NAV continues to pursue these tasks, it contributes in large measure to IMO's mission—safe, secure, and efficient shipping on clean oceans.

Endnote:

1. http://www.imo.org

About the author:

Mr. LaRue holds a B.S. in marine transportation from the State University of New York Maritime College. He sailed for nine years as a deck watch officer on various ships as a member of the International Organization of Masters, Mates, and Pilots. Mr. LaRue is presently the chief of the Navigation Standards Division in the U.S. Coast Guard Marine Transportation Systems Management Directorate. He has been a member of the U.S. delegation to the IMO Subcommittee on Safety of Navigation for more than 20 years.

e-Navigation

Revolution and evolution.

by Mr. Bill Cairns, F.R.I.N.
IALA e-Navigation Committee Chairman

In the summer 2007 *Proceedings* I wrote about "The e-Navigation Revolution." Now, nearly four years later, the maritime world is en route to e-Navigation, but will likely need occasional course corrections to get there.

The Office of Navigation Systems in the U.S. Coast Guard Marine Transportation Management Directorate is continuing to help define and shape e-Navigation through its efforts at the International Maritime Organization (IMO) and the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) e-Navigation Committee. Domestically, the office is the lead for developing a U.S. e-Navigation strategy for the Committee on the Marine Transportation System.

International Maritime Organization Efforts

In May 2006, the IMO Maritime Safety Committee approved a new work item on e-Navigation for its subcommittee on Safety of Navigation. Because of its reliance on communications systems and the potential impact on training of mariners, e-Navigation is also being considered at the subcommittees on Radiocommunications and

What Does the "e" Stand For?

The International Maritime Organization has agreed on the following definition:

"e-Navigation is the harmonised collection, integration, exchange, presentation, and analysis of maritime information onboard and ashore by electronic means to enhance berth-to-berth navigation and related services, for safety and security at sea and protection of the marine environment."

So, the "e" could stand for "enhanced" or "electronic," but these might limit what can be considered e-Navigation. It is generally accepted that e-Navigation is, in effect, a brand name, and the "e" is not specifically defined.

Search and Rescue and Standards of Training and Watchkeeping.

In July 2010, the Safety of Navigation subcommittee endorsed initial gap, cost benefit, and risk analyses. It also approved e-Navigation user needs and invited IALA and the International Hydrographic Organization to finalize gap analyses on shore-side aspects of e-Navigation. Additionally, a dedicated correspondence group on e-Navigation was re-established.

During the next year, the correspondence group is expected to finalize the system architecture and progress the gap analyses focusing on technical, regulatory, operational, and training aspects. The group will report to the Standards of Training and Watchkeeping Subcommittee and elicit any feedback regarding training and watch keeping issues. At the next meeting of the subcommittee on Radiocommunications and Search and Rescue in March 2011 it is expected the report will outline an overall conceptual, functional, and technical architecture, noting the progress made in the initial gap analyses, and will focus on communication and SAR issues.

Automatic Identification System aid to navigation. Courtesy of Zeni Lite.

Subsequently, the correspondence group plans to outline further analyses for navigation and related shore-based services issues and produce a provisional draft of an e-Navigation strategy implementation plan, which will describe the data framework that will support user needs and ensure maximum interoperability.

The International Maritime Organization is also looking to other intergovernmental and non-governmental organizations to contribute to and support its work. For example, it is collaborating with the International Telecommunications Union to consider further use of the 500 KHz band in support of e-Navigation.

International Association of Marine Aids to Navigation and Lighthouse Authorities

While IMO may be viewed as the captain of the e-Navigation ship, IALA, as one of the prime technical arms of this effort, could be considered the chief engineer. Not surprisingly, the chief is hard at work.

The IALA e-Navigation Committee, formed from its Radionavigation and AIS Committees, is structured specifically to support the IMO. As such, IALA's e-Nav Position, Navigation, and Timing Working Group is working to identify and examine all technologies that may contribute to effective position, navigation, and timing, including radar and associated aids to navigation, terrestrial positioning systems, global navigation satellite systems augmentation, visual and optical techniques, echo sounders, inertial navigation, and alternative uses of existing systems.

Additionally, the Portrayal Working Group will evaluate new proposals for displaying e-Navigation-related information, including AIS application-specific messages, virtual AtoN, and marine information overlays. The users of e-Navigation services are represented in the Operations Working Group and contribute to the IMO e-Navigation implementation plan by assessing operational issues pertinent to user needs, gap analysis, cost-benefit analysis, and associated implementation issues.

The Automatic Identification System Technical Working Group is focusing on efforts including AIS aids to

navigation, satellite detection, terrestrial long-range AIS, and the next generation of AIS.

Future data collection and exchange needs will provide the impetus for communications systems of broader capabilities than VHF-based AIS. With this in mind, the e-Navigation Committee created the Communications Working Group to study operational and technical requirements for communications and information systems in e-Navigation, including the Global Maritime Distress and Safety System and maritime information systems, and evaluate communication channels within other frequency bands.

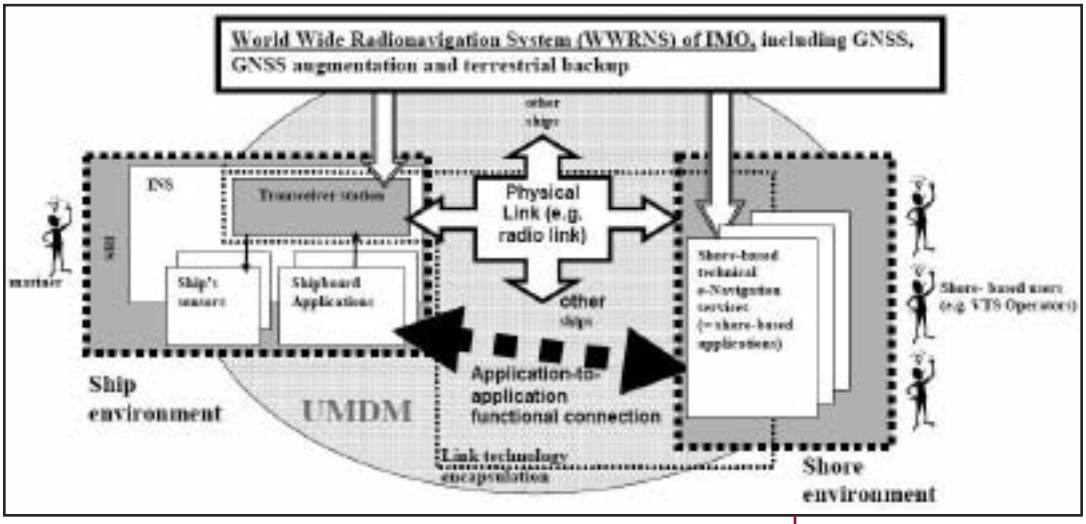
The committee's Architecture Technical Working Group is working to harmonize sensor and architecture integration. In addition to creating the conceptual and technical framework for a shore-based e-Navigation system, the architects are developing a data model and an "e-Navigation stack" analogous to the International Organization for Standardization open systems interconnection stack.

This leads to another cog in the e-Navigation machine—the interface with the International Hydrographic Organization (IHO), which has been at the heart of the development of electronic navigational charts for many years. IHO has built electronic navigational chart data presentation and transfer standards leading to a template for a new data model known as S-100: IHO Hydrographic Geospatial Standard for Marine Data and Information. While the S-100 focuses on hydrographic data, it is also a template for other navigation-related data. Looking toward a harmonized data model for e-Navigation, the coordinator of the IMO Correspondence Group held a workshop on data models at IHO headquarters in November 2010.

It is important to note that IALA and IHO are regular participants at IMO. The chair of the IMO Correspondence Group on e-Navigation and a member of the IMO Secretariat participate in the IALA e-Nav Committee, as do several representatives of the International Hydrographic Organization.

Committee on the Marine Transportation System

In the domestic discussions surrounding e-Navigation, similar strong relationships also exist through the Committee on the Marine Transportation System (CMTS), which is a federal inter-departmental committee chaired by the Secretary of Transportation to create a partnership of federal departments and agencies with responsibility for the marine transportation system. The CMTS works to develop and implement national marine transportation system policies that are consistent with national needs and reports its views and recommendations to the president.



IALA e-Navigation architecture. GNSS = Global Navigation Satellite System; UMDM = Universal Maritime Data Model.

At its April 2010 meeting, the coordinating board approved an interagency e-Navigation task team to be led by the U.S. Coast Guard to develop an e-Navigation national strategy to inventory the suite of federal e-Navigation services to harmonize activities and determine priorities. The strategy will describe how the U.S. will implement e-Navigation concepts coordinated with industry and other stakeholders to protect the safety and efficiency of the U.S. marine transportation system.

About the author:

Mr. William R. Cairns is the principal navigation engineer in the U.S. Coast Guard headquarters Marine Transportation Systems Management Directorate and chairman of the IALA e-Navigation Committee. A retired Coast Guard officer, he has served on U.S. delegations to the IMO Maritime Safety Committee and NAV and COMSAR Subcommittees and is currently coordinator of the NAV Correspondence Group. He is a fellow of the Royal Institute of Navigation.

The Automatic Identification System

Then, now, and in the future.

by Mr. Jorge Arroyo
Program and Management Analyst
U.S. Coast Guard Office of Navigation Systems, Electronic Navigation Division

After the *Exxon Valdez* oil spill in 1989, Congress enacted the Oil Pollution Act of 1990, which changed how we deal with oil pollution prevention and response and made participation in Coast Guard vessel traffic services (VTS) mandatory. One other important provision in the law was the mandate to create a dependent surveillance system to monitor tankers navigating to and from Valdez, Alaska.

Room for Improvement

Prior to this incident, vessel traffic services typically provided vessel information by inquiring about vessels' intentions and tracking their movement within the system via some manual plotting board or similar device. Though the inclusion of radar greatly enhanced the ability to track and monitor vessel movements, its range is limited, so the cost of providing full radar coverage throughout an entire VTS area and its approaches was prohibitive. Further, radar does not provide the ability to positively identify a vessel among other vessels or physical objects, such as ice. This limitation was always known, but became more evident after the *Exxon Valdez* disaster.

The U.S. Coast Guard Office of Vessel Traffic Management researched various means to improve vessel tracking, opting to modify the digital selective calling (DSC) communications protocol relied upon for Global Marine Distress Safety System alerts. DSC allows for scheduled broadcasts and the ability to poll for information, which led to a shipboard system that would allow specific very high frequency (VHF) DSC messages composed of vessel identity and position for tracking purposes. This technology eventually became automated dependent surveillance shipboard equipment.

As we ventured to track tankers, other countries and authorities also sought ways to track and monitor vessels transiting unique waterways, such as the Panama Canal, the Dover Straits, and the fjords of Sweden. In each of these areas, authorities came up with their own unique method. The British used DSC messaging similar to us, the Panamanians opted for a system using ultra-high frequency, and the Swedes used a system similar to cell phone technology, but via a VHF frequency. While all these systems quickly showed the value of automated vessel tracking, they were not interoperable.

Mandating Universal Standards

To avoid an even further proliferation of disparate systems, an effort arose to develop a universal, world-wide means to automatically identify vessels, and in 2000, the International Maritime Organization mandated universal automatic identification system use on all tankers, passenger vessels of 150 gross tonnage or greater, and other ships of 300 gross tonnage or greater (500 gross tonnage or greater in domestic voyages).

This system was designed to:

- improve navigation safety through automatic use,
- be used in a ship-to-ship mode for collision avoidance,
- be used as a means for littoral states to obtain information about a ship and its cargo,
- be used as a VTS tool for traffic management.

continued on page 55

Frequency Information

AIS primarily operates on two world-wide designated radio channels—VHF-FM channel 87B and 88B—but to ensure its universality, the system also operates on any channel in the VHF-FM band for areas where the designated frequencies may be unavailable.

To further provide robustness, AIS communicates using a time-division multiple access scheme, which allows several users to share the same frequency channel by dividing the signal into different time slots. The users transmit in rapid succession, each using his own time slot.

Timing Scheme

During development, each AIS station reserved specific slots for its use to ensure it didn't use a slot reserved by another station. This prevents communications from "stepping on" each other, as is common in voice or DSC communications. Further, this schema was designed so those vessels in closer proximity would prevail over weaker signals, so vessels that could pose a greater risk for collision would be heard above those farther away.

INTERNATIONAL TELECOMMUNICATION UNION RECOMMENDATION

Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band.

M = Mobile
B = Base Station

Message Library

Message ID	Message Name	Description	Transmit Priority	Purpose	Station Type
1	Position report	Scheduled position report; (Class A shipboard mobile equipment)	1	Position report from mobile stations output periodically, according to the current speed over ground (SOG), rate of turn (ROT), and navigational status setting, unless specified otherwise by reception of a message 16 or 23.	M
2	Position report	Assigned scheduled position report; (Class A shipboard mobile equipment)			
3	Position report	Special position report, response to interrogation; (Class A shipboard mobile equipment)			
4	Base station report	Position, UTC, date, and current slot number of base station	1	Used for reporting UTC time, date, and position. A base station should use message 4 in its periodical transmissions. A mobile station should output message 11 only in response to interrogation by message 10.	B
5	Static and voyage related data	Scheduled static and voyage-related vessel data report; (Class A shipboard mobile equipment)	4	Used by Class A shipboard and SAR aircraft AIS stations when reporting static or voyage-related data.	M
6	Binary addressed message	Binary data for addressed communication	4	An addressed binary message variable in length, based on the amount of binary data. The length will vary between one and five slots.	M/B
7	Binary acknowledgement	Acknowledgement of received addressed binary data	1	Used as an acknowledgement of up to four message 6 messages received, and transmitted on the channel, where the addressed message to be acknowledged was received.	M/B
8	Binary broadcast message	Binary data for broadcast communication	4	A message of variable length, based on the amount of binary data. The length should vary between one and five slots.	M/B
9	Standard SAR aircraft position report	Position report for airborne stations involved in SAR operations, only	1	Used as a standard position report for aircraft involved in SAR operations. Stations other than aircraft involved in SAR operations should not transmit this message. The default reporting interval for this message is 10 seconds.	M

Message ID	Message Name	Description	Transmit Priority	Purpose	Station Type
10	UTC/date inquiry	Request UTC and date	3	Used when a station is requesting universal time coordinated and date from another station.	M/B
11	UTC/date response	Current UTC and date if available	3	Same as message 4.	M
12	Addressed safety-related message	Safety-related data for addressed communication	2	An addressed safety-related message of variable length, based on the amount of safety related text. The length will vary between one and five slots.	M/B
13	Safety-related acknowledgement	Acknowledgement of received addressed safety-related message	1	Same as message 7.	M/B
14	Safety-related broadcast message	Safety-related data for broadcast communication	2	A safety-related broadcast message variable in length, based on the amount of safety-related text. The length will vary between one and five slots (up to 156 characters).	M/B
15	Interrogation	Request for a specific message type (can result in multiple responses from one or several stations)	3	Used for interrogations via the AIS VHF data link other than requests for UTC and date. The response should be transmitted on the channel where the interrogation was received.	M/B
16	Assignment mode command	Assignment of a specific report behavior by competent authority using a base station	1	Used by a base station when operating as a controlling entity. Other stations can be assigned a transmission schedule other than the currently used one. If a station is assigned a schedule, it will also enter assigned mode. Two stations can be assigned simultaneously.	B
17	Differential broadcast binary message	Differential position corrections provided by a base station	2	Used by a base station connected to a GPS reference source and configured to provide differential GPS data to receiving stations.	B
18	Standard Class B equipment position report	Standard position report for Class B shipboard mobile equipment to be used instead of messages 1, 2, 3	1	Used by Class B shipboard mobile equipment to report position periodically and autonomously instead of messages 1, 2, or 3 at a 30-second reporting interval, unless otherwise specified by reception of a message 16 or 23, and depending on the current SOG and navigational status flag setting.	M
19	Extended Class B equipment position report	Extended position report for class B shipboard mobile equipment; contains additional static information	1	Used by Class B shipboard mobile equipment; transmitted once every six minutes in two slots allocated by the use of message 18 in the communication state or after the following parameter values change: dimension of ship/reference for position or type of electronic position fixing device.	M
20	Data link management message	Reserve slots for base station(s)	1	Used by base station(s) to pre-announce the fixed allocation schedule for one or more base station(s) and it should be repeated as often as required; thus ensures a high level of integrity for base station(s) transmissions. This is especially important in regions where several base stations are located adjacent to each other and mobile station(s) move between these different regions. These reserved slots cannot be used by mobile stations.	B

Message ID	Message Name	Description	Transmit Priority	Purpose	Station Type
21	Aids-to-navigation (AtoN) report	Position and status report for aids to navigation	1	Used by an AtoN AIS station mounted on an aid-to-navigation or a fixed station; when the functionality of an AtoN station is integrated into the fixed station. It is nominally transmitted autonomously once every three minutes or may be assigned by an assigned mode command (message 16) via the VHF data link, or by an external propriety command. This message is limited to no more than two slots.	M/B
22	Channel management	Management of channels and transceiver modes by a base station	1	Used by a base station (as a broadcast message) to command the VHF data link parameters for the geographical area designated in this message. Alternatively, this message may be used by a base station (as an addressed message) to command individual AIS mobile stations to adopt the specified VHF data link parameters (frequency and/or output power). When interrogated and no channel management performed by the interrogated base station, the not available and/or international default settings (AIS 1 and AIS 2) should be transmitted.	B
23	Group assignment command	Assignment of a specific report behavior by competent authority using a base station to a specific group of mobiles	1	Used by a base station when operating as a controlling entity to control mobile station's: –transmit/receive mode; –reporting interval; or –the duration of a quiet time by "ship and cargo type" or by "station type."	B
24	Static data report	Additional data assigned to an MMSI Part A: Name Part B: Static Data	4	May be used by any AIS station to associate a MMSI with a name. Message 24 Part A and Part B is used by Class B "CS" shipboard mobile equipment. When doing so the message consists of two parts. Message 24B should be transmitted within one minute following message 24A. In case of an interrogation for a Class B "CS" on a message 24, the response includes part A and part B data.	M/B
25	Single slot binary message	Short unscheduled binary data transmission (broadcast or addressed)	4	Use for short infrequent data transmissions. The single-slot binary message can contain up to 128 data-bits depending on the coding method used for the contents, and the destination indication of broadcast or addressed. Its length is limited to one slot. This message will not be acknowledged by either message 7 or 13.	M/B
26	Multiple slot binary message with communications state	Scheduled binary data transmission (broadcast or addressed)	4	Primarily intended for scheduled binary data transmissions per its respective VHF data link access scheme. This multiple-slot binary message can contain up to 1,004 data-bits (up to 5 slots) depending on the coding method used for the contents, and the destination indication of broadcast or addressed. This message will not be acknowledged by either message 7 or 13.	M/B
27	Position report for long-range applications	Scheduled position report; (Class A shipboard mobile equipment outside base station coverage)	1	Primarily intended for long-range detection of AIS Class A equipped vessels (typically by satellite). This message has a similar content to messages 1, 2 and 3, but the total number of bits has been compressed to allow for increased propagation delays associated with long-range detection.	M

Technical Standards

The International Telecommunication Union adopted this schema into the AIS technical standard, which defines a finite library of fixed-length messages particular to each AIS station type, including:

- shipboard Class A units,
- less capable shipboard Class B stations,
- search and rescue aircraft,
- AIS aid to navigation stations,
- base stations.

The library also provides for short safety-related text messages, including a common message used by most AIS stations to interrogate and poll other AIS stations for their specific message or for time. In addition, the library provides a subset of messages that are to be used solely by the base station to control the behavior of other stations or the VHF data link, each assigning a different reporting rate, operation frequency, output level, and segment of the data link.

That Was Then

Today we track more than 7,000 vessels a day via a shore-side network of Coast Guard VTS transceivers and AIS receiver stations through our nationwide automatic identification system. In addition to our land network, we have also received AIS reports from what was initially a Coast Guard project to receive and decode AIS from commercial satellites. Most nations are doing the same, monitoring their waters with similar land-based networks, and efforts are underway to share this information.[1]

What does the future hold for AIS? Recent developments promise to reap great rewards for decades to come.

AIS SART. Most commercial ships are required to have lifeboats equipped with radar search and rescue transponders. Responders rely on these transponders to "home in" on deployed lifeboats. As such, they have been instrumental in saving many lives, but as mentioned previously, radar has limitations. Enter AIS.

Just as AIS was seen as another effective means to allow for the positive tracking of vessels, why not use its capability to home in on vessels such as lifeboats? Thus began an effort to develop an AIS-based search and rescue transmitter (AIS SART).

The U.S. Coast Guard conducted trials with prototype AIS search and rescue transmitters designed to broadcast in eight-second bursts to ensure the equipment broadcasts at least once on the crest of a wave. In all trials AIS SART performance far exceeded the radar counterpart. Aircraft flying at 20,000 feet were able to detect an AIS SART from more than 120 nautical miles, while radar search and rescue transponders only came within range at one-half to one-third the distance. Additionally, the new technology sends a GPS-derived position report, which promises to reduce the "search" in search and rescue operations.

Following various successful trials conducted by the U.S. Coast Guard, the Northern Light Board of Scotland, U.K. maritime authorities, and the Federal Waterways Administration in January 2010, the IMO allowed AIS SART use in lieu of the previous technology.

AIS ASM. Also in the technological forefront, the IMO has adopted a compendium of application-specific messages (ASM) that promise to greatly enhance AIS users' navigation safety. These applications will provide for the exchange of:

- environmental, meteorological, and hydrological data;
- reporting dangerous cargo and/or persons;
- port clearance and berthing information;
- mandatory and recommended routes;
- amplifying vessel static and voyage-related data;
- VTS or synthetic targets (vessels without AIS);
- pertinent time-critical dynamic navigation information concerning a specified geographic area, poly-line, or position.

AIS SAT. Finally, the latest change to the AIS technical standard includes a message specifically designed for AIS reception from satellite (AIS SAT). To enhance AIS satellite reception, the U.S. developed a new automatic identification service message in which the number of bits has been compressed to improve long-range detection.

However, another large challenge remains. The self-organizing nature of AIS, which is optimal for ship-to-ship communications, poses a unique dilemma to satellite receivers and their much larger reception area or footprint, given their altitude. Thus, satellite providers must devise ways to decipher multiple AIS messages using the same time slot.

The most effective way to avoid these "slot collisions" is to reduce AIS congestion. This is not possible on the existing AIS channels, given the ever-increasing number of AIS users, but could be accomplished if other channels were used for this new message. To that end, the U.S. is leading an effort to designate two additional VHF-FM channels for long-range AIS reporting.

About the author:

Mr. Arroyo is a program and management analyst in the Office of Navigation Systems at USCG headquarters and the USCG's regulatory project officer and subject matter expert for the Automatic Identification System (AIS). Since 1980 he has worked various assignments and duties in recreational boating safety, search and rescue, vessel traffic management, polar icebreaking, and ship and shore-side operations. He also currently serves as the U.S. delegate to the International Maritime Organization Navigation Sub-Committee, is a member of various working groups of the International Electrotechnical Committee (IEC) and Radio Technical Committee for Maritime Services (RTCM), and is vice-chair of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) AIS working group.

He obtained his Bachelor of Science from the University of Illinois, his Juris Doctor from DePaul Law School in Chicago, Illinois, and has sailed the seven seas and made landfall on every continent.

Endnote:

[1] *Proceedings of the Marine Safety & Security Council*; Summer 2010, Vol. 67, No.2; p. 18.

Internationally adopted AIS Application-Specific Messages

Application Name	Purpose
Number of persons on board	Used by a ship to report the number of persons on board (e.g., on request by a competent authority).
VTS-generated/synthetic targets	Used to transmit known VTS or other types of synthetic targets. It can be variable in length, based on the amount of targets; up to four targets.
Clearance time to enter port	Used to provide specific ships with information on the granted port to call and time to enter; including the berth's location code (UNLOCODE) and position.
Marine traffic signal	Used to provide information on a signal station and status of the control signal at the entrance of a harbor or channel where the shipping direction controlled so that the traffic flow be kept in order. It provides the name of signal or station, position of station, status of signal, signal in service, time of next signal shift, expected next signal.
Berthing data	Used to provide information on the ship's berth. If sent from a ship it is a berthing request; if it is transmitted by a competent authority it is a berthing assignment, which includes: berth length, water depth at berth, mooring position, available berth date and time, services availability, type of services available, name of berth, centre position of berth.
Weather observation report from ship	Used to provide weather information as observed on a ship in navigation. Two different messages can be transmitted: Weather observation report from ship or World Meteorological Organization (WMO) weather observation reports from ship.
Area notice – broadcast – addressed	Used to provide pertinent time-critical dynamic navigation information concerning a specified geographic area, poly-line or positions, but not as a means to convey information already provided by current official nautical charts or publications. It can also be used to convey advisory lines or tracks. It is time-dependent (i.e. has start date and time and duration). It can be sent as either an addressed or broadcast message.
Extended ship static and voyage-related data	Used to provide additional extended and static voyage-related data from a ship, such as: air draught, last port of call, next port of call, second port of call, SOLAS equipment status, hull ice class, shaft horse power, VHF working channel, Lloyd's ship type, gross tonnage, laden or ballast status, type of bunker oil on board, total amount of bunker oil in tonnes, number of persons on board.
Dangerous cargo indication	Used in response to a request for a summary of the dangerous cargo information from a competent authority. It is intended to provide a non-verbal method of transfer of information on the general categories on dangerous cargoes, i.e. as an outline assessment of the categories of ships and their cargoes to facilitate in their participation in ship reporting systems and as initial information supporting search and rescue (SAR), anti-pollution, fire/chemical response or other incident/accident response operations. The data is intended for use by the shore-based authority with the ability to relay this information on a selective and secure basis to the relevant national authorities responsible for receiving reports (i.e. Maritime Reporting System) and for VTS, SAR, pollution response, fire-fighting, and other shore-based activities in response to accidents or incidents.
Environmental	Used to provide environmental information from one to eight environmental sensors (e.g., one sensor report uses two slots while a message with eight sensor reports can use up to five slots). Each sensor report carries the dynamic or static information relating to a specific sensor, such as: wind, water level, current flow (2D), current flow (3D), horizontal current flow, sea state, salinity, weather, air gap/air draft, etc.
Route information – broadcast – addressed	Used to communicate pertinent vessel routing information; when important route information [e.g., mandatory or recommended route(s)] – not already provided by current official nautical charts or publications – needs to be relayed by authorities or vessels. It can be broadcast or addressed, depending on which alternative is more appropriate.
Text description – broadcast – addressed	Used to provide a text description in combination with other AIS application-specific message (e.g., area notice or route information). It can be broadcast or addressed, however, the same source MMSI must be used to send both the main message and a text description message.
Meteorological and hydrographic data	Used to allow the distribution of meteorological and hydrographic information directly from the sensor source, e.g. current velocity.
Tidal window	Used to inform vessels about tidal windows which allow a vessel the safe passage of a fairway or waterway. It includes predictions of current speed and current direction. Up to three points of tidal information can be provided. (IMO SN.1/Circular 289)

AIS-SAT graphic courtesy of exactEarth Ltd. and the Environmental Systems Research Institute, Inc.

Automatic Identification System Broadcast Information

Mobile Stations (Class A and Class B shipboard equipment)

- Dynamic data every two to 10 seconds per speed and course change (Class B, 30s only).
- Position and accuracy (+/-10m)
- Position integrity via receiver autonomous integrity monitoring
- Course over ground
- Speed over ground
- Heading
- Rate of turn*
- Universal time-coordinated time stamp via GPS
- Vessel IMO number *
- Navigation status *
- Communication state (slot usage)

Static and voyage-related data every six minutes or upon change.

- Type of positioning source
- Vessel dimensions (derived from AIS reference point)
- Vessel name
- Vessel call sign
- Vessel type
- Static draft*
- Hazardous cargo flag*
- Destination and ETA*
- Data terminal (external AIS display) availability

* Unavailable from Class B equipment

Search and Rescue Aircraft

- Universal time-coordinated time stamp via GPS
- Position and accuracy (+/-10m)
  - Position integrity via receiver autonomous integrity monitoring
- Altitude sensor
- Course over ground
- Speed over ground
  - Communication state (slot usage)
  - Data terminal (external AIS display) availability

Search and Rescue Transmitter

- Universal time-coordinated time stamp via GPS
- Navigation status that indicates it is an active SART
- Associated text message that states either SART "active" or SART "test"
- Position and accuracy (+/-10m)
  - Position integrity via receiver autonomous integrity monitoring
- Course over ground
- Speed over ground
  - Communication state (slot usage)

Base (Shore) Stations

- Universal time-coordinated
- Position and accuracy (+/-10m)
- Position integrity via receiver autonomous integrity monitoring
- Type of positioning source
- Communication state (slot usage)

Aid to Navigation Station

- ATON name
- Type of ATON
- ATON dimension (reference point)
- ATON status
- Off-position indicator
- Position and accuracy (+/-10m)
  - Position integrity via receiver autonomous integrity monitoring
- Universal time-coordinated time stamp via GPS
- Virtual ATON indication
- Broadcast mode (autonomous or assigned)

Most stations can also perform safety-related and application-specific messaging

- Short text messaging < 156 characters
  - Addressed (and acknowledgement) or general broadcast
- Data messaging and binary applications

Coast Guard Cooperation in the Arctic

USCGC Healy's *continental shelf mission.*

by LCDR Michael Krause
Chief, U.S. Coast Guard Mobility and Ice Operations Division

Dr. Jonathan Berkson
Marine Science Program Manager
U.S. Coast Guard

In recent years, our nation's Arctic economic, environmental, and security interests have escalated as reduced ice extent provides increased accessibility to the Arctic. Various other Arctic nations seized opportunities to submit territorial claims and retain potential fuel and marine resources. As commercial interests plan for offshore drilling, this raises the specter of marine environmental pollution and spills of national significance. Additionally, it is no longer uncommon for passenger and commercial cargo vessels to venture into the Arctic, navigating in relatively uncharted waters, far from disaster assistance.

For the last 140 years, the Coast Guard has placed itself at the forefront of Arctic operations as icebreakers and ice-strengthened cutters from the Revenue Cutter *Bear* to USCGC *Healy* conducted law enforcement, community outreach, regional exploration, defense operations, research support, and search and rescue missions.

Over the past few decades, primary icebreaker operations shifted from traditional Coast Guard missions to focus more on polar region scientific support as well as ship escorts and channel breakouts for Thule Air Force Base in Greenland and McMurdo Station in Antarctica. As the need for traditional Coast Guard mission support in the polar regions re-emerges, icebreakers will prove invaluable in supporting national polar interests.

Extended Continental Shelf Project

In 2002, the National Oceanic and Atmospheric Administration and the University of New Hampshire Joint Hydrographic Center examined geological and geophysical data and identified several potential U.S. extended continental shelf claims (see sidebar). Approximately half the claim area is off the Alaskan coast. In 2003 the U.S. began collecting data to determine the outer limits of its extended continental shelf (ECS) for a potential United Nations Convention on the Law of the Sea (UNCLOS) claim.[1] The Arctic Ocean claim has become a primary focus of several Arctic nations, especially as the ice cover that previously prevented access to potentially significant oil and gas resources recedes.

Although the U.S. is not yet a party to UNCLOS, it can make an extended continental shelf claim under the customary international law UNCLOS reflects (the same authority under which it claims its exclusive economic zone). However, the U.S. will not have access to UNCLOS procedures for full international recognition and legal certainty for its claims.[2] Once the U.S. accedes to UNCLOS, it will have 10 years to submit its claim.

Coast Guard Arctic Surveys

The ECS task force is an interagency body tasked to determine the U.S. ECS, and has collected survey data for

USCGC *Healy*

The Coast Guard commissioned the icebreaker *Healy* in 2000. Its equipment includes multiple heavy cranes, state-of-the-art laboratories, reconfigurable working spaces, extensive computer systems, a highly automated engineering plant, modern navigational equipment, a voyage management system, and upgraded sensors. While capable of performing a wide range of missions in support of U.S. interests in both polar regions, it is designed and outfitted to support Arctic science research.

For example, the data *Healy* collected in the Arctic has led to significant discoveries and provided direction for future research. The discovery of bathymetric "pockmarks" and glacial scouring features is changing our understanding of seafloor processes. Two new seamounts have been discovered, including one now named the "Healy Seamount." New bathymetry has also helped the Navy better understand Arctic gravity data used in submarine guidance systems.

During an Arctic domain awareness flight, VADM Sally Brice-O'Hara (left) watches as the Coast Guard Cutter *Healy* breaks ice along with the Canadian Coast Guard ship *Louis S. St-Laurent*. U.S. Coast Guard photo by Air Station Kodiak.

this purpose. However, the Arctic ECS claim exploration presents unique challenges due to sea ice and the harsh environment. USGCC *Healy*'s icebreaking capabilities make it an ideal survey platform. Its onboard sensor, the multi-beam sonar, has proven invaluable in gathering bathymetric (underwater depth) data.

Additionally, U.S. and Canadian icebreakers conducted joint ECS cruises in 2008, 2009, and 2010 to support each country's ECS claim, with another joint deployment possible in 2011. In these joint efforts, one icebreaker would break the path so the other's sensors would be less subject to shock and vibration; also, if an icebreaker found itself beset, the other icebreaker would help free it.

Through extensive use of sensors and cooperation with Canada, the U.S. has achieved a head start in collecting and analyzing data for an ECS claim likely to be among the largest in the world. The U.S. and Canada have demonstrated their ability to work together to achieve both countries' Arctic aims, further highlighting the

need for cooperation among the Arctic nations as the region becomes more accessible.

Endnotes:

1. ECS Project, http://continentalshelf.gov.
2. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, "ECS Frequently Asked Questions, Fact Sheet."

About the authors:

LCDR Michael Krause is the chief of the U.S. Coast Guard Mobility Division and the polar icebreaker program manager. A career cutterman, he has six years' experience on icebreakers, patrol boats, and medium-endurance cutters.

Dr. Jonathan Berkson is the marine science program manager for the U.S. Coast Guard. He holds a Ph.D. in geophysics from the University of Wisconsin-Madison.

Extended Continental Shelf

The United Nations Convention on the Law of the Sea (UNCLOS) allows a coastal nation to claim an exclusive economic zone out to 200 nautical miles from its shore or out to a maritime boundary with another coastal nation.

This nation, then, has sovereign rights over all resources in the water column and in the seabed of its exclusive economic zone. UNCLOS allows some coastal nations to further claim an extended continental shelf (ECS) beyond 200 miles if the shelf meets certain physical criteria.[1]

While a nation's rights over seabed and subsoil resources are protected in the ECS, it does not necessarily enjoy sovereign rights over resources in the water column. A nation desiring to present an ECS claim must collect and analyze data describing the depth, shape, and geophysical characteristics of the seabed and subsoil as well as the thickness of the underlying sediments. Geophysical data such as bathymetry, seismic refraction, magnetic and gravity data, and seafloor cores and supporting physical samples may all prove necessary in a nation's determination of the ECS's outer limits.[2]

Endnotes:

1. Margaret Hayes, "The U.S. Extended Continental Shelf (ECS)," Ocean Seminar Series, Environmental Law Institute, 2009.
2. Department of State, Bureau of Oceans and International Environmental and Scientific Affairs, "ECS Frequently Asked Questions, Fact Sheet."

The Canadian Coast Guard ship *Louis S. St-Laurent* makes an approach to the Coast Guard Cutter *Healy* during an Arctic survey mission. U.S. Coast Guard photo by Petty Officer Patrick Kelley.

International Ice Patrol

Guardians on the Grand Banks.

by CDR Lisa Mack
Commander
U.S. Coast Guard International Ice Patrol

Ice Patrol History

International Ice Patrol was established by international convention as a direct result of the 1912 sinking of the *Titanic*. Since 1913, with the exception of wartime, the U.S. Coast Guard has maintained an ice patrol that monitors 500,000 square miles of ocean in the North Atlantic.

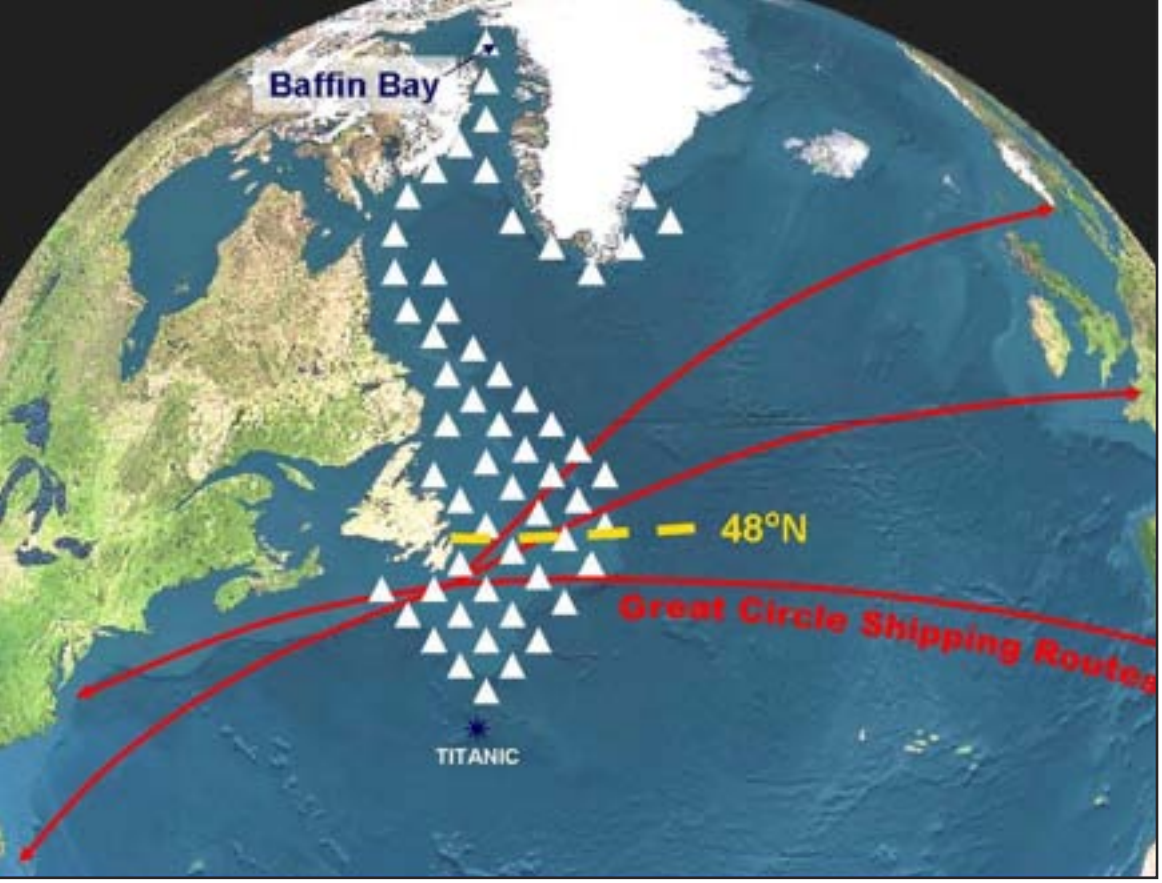
Until 1941, iceberg detection relied on visual sightings from patrol cutters. As aircraft performance improved, the Ice Patrol integrated aircraft into reconnaissance operations. After 1960, surface patrol craft took a secondary role to aerial reconnaissance, and the AN/APS-135 side-looking airborne radar became the primary iceberg detection tool in 1983. The AN/APS-

Ice Patrol in a Changing World

The maritime shipping industry has changed dramatically in the last century. Modern cruise ships are longer, have significantly more gross tonnage, and are capable of greater speeds than the *Titanic*. While the number of vessels displacing over 100 tons has almost quadrupled since 1914, automation and technology have allowed smaller crews to handle these larger vessels. Navigational aids have become more precise, and improvements in communication—especially satellite communication—allow much more data to be shared with vessels at sea.

In addition to changing vessel capabilities, the environment is changing. The annual sea ice minimum in the Arctic has reduced dramatically, potentially opening previously inaccessible areas to shipping and oil and gas mining and changing the frequency and precision of necessary iceberg location information.

In response, Ice Patrol is working with its Canadian partners to integrate an updated iceberg drift and deterioration model into current processes. In addition, potential reconnaissance improvements include new data sources (including satellite data), resources, and sensors. These improvements are priorities for both services and key elements in moving toward a common data system within the North American Ice Service.



Maritime traffic between Europe and North America typically follows "great circle" routes that cross the Grand Banks. The white triangles represent the average potential extent of annual iceberg limit. These shipping lanes are the only location in the world where icebergs endanger a major shipping route. USCG graphic.

137 forward-looking radar was added a decade later, and in 2009 reconnaissance aircraft transitioned to the HC-130J equipped with the ELTA-2022 360-degree radar that provides identification capability even when visibility is poor.

Ice Patrol Today

Maritime traffic between Europe and North America typically follows routes that are intersected annually by an average of 500 icebergs. This is the only location in the world where icebergs endanger a major shipping route, and Ice Patrol provides accurate and timely iceberg information to assist transatlantic mariners in avoiding them.

Ice Patrol receives numerous iceberg reports from aircraft and mariners and collects its own ice sightings, sea surface temperatures, and weather information year-round. Ice information is evaluated for accuracy and timeliness and entered in a computer model, which uses current, temperature, and wind data to model iceberg drift and deterioration and estimate the "iceberg limit." Ice Patrol then distributes an ice bulletin and ice chart showing the iceberg danger area.

Partnerships

In supporting the maritime transportation system, Ice Patrol partners with several organizations. For example, Ice Patrol has a close working relationship with the Canadian Ice Service, which shares a synchronized iceberg database that provides backup capabilities for each service. The private companies C-CORE and Provincial Aerospace Limited also share reconnaissance and research and development data with Ice Patrol.

Additionally, Ice Patrol, the Canadian Ice Service, and the National Ice Center entered a collaborative agreement called the North American Ice Service with the vision of becoming the unified source of ice information for North America. Toward this end, the Canadian Ice Service and International Ice Patrol are harmonizing their iceberg charts to produce one North American Ice Service chart. Ice Patrol will be responsible for the chart from February through August, when icebergs generally threaten transatlantic mariners, and the Canadian Ice Service will produce the chart during the remaining months of the year.

Risk of Iceberg Collision

Iceberg collisions as recent as 2010 serve as a reminder that icebergs still pose a threat to shipping, and the need for iceberg information is still critical to balancing safety and mobility in the North Atlantic.

The Ice Patrol has greatly expanded the scientific understanding of iceberg drift and deterioration while protecting life and property at sea and facilitating transatlantic commerce.

Finally, in nearly a century on the job, Ice Patrol has established the enviable safety record that not a single ship heeding the published limit has collided with an iceberg.

About the author:
CDR Mack is a graduate of the U.S. Coast Guard Academy and holds an M.S. in oceanography from the University of Washington. She has experience in polar and domestic icebreaking. Prior to taking command of the International Ice Patrol, she served as chief of the Mobility and Ice Operations Branch at U.S. Coast Guard headquarters.

Lessons Learned

from Casualty Investigations

Elizabeth M

Zim Mexico III / Lee III

A regular feature in Proceedings: "Lessons Learned From USCG Casualty Investigations."

In this ongoing feature, we take a close look at recent marine casualties. We explore how these incidents occurred, including any environmental, vessel design, or human error factors that contributed to each event.

We outline the U.S. Coast Guard marine casualty investigations that followed, describe in detail the lessons learned through them, and indicate any changes in maritime regulations that occurred as a result of those investigations.

Unless otherwise noted, all information, statistics, graphics, and quotes come from the investigative report. All conclusions are based on information taken from the report.

Lessons Learned from Casualty Investigations

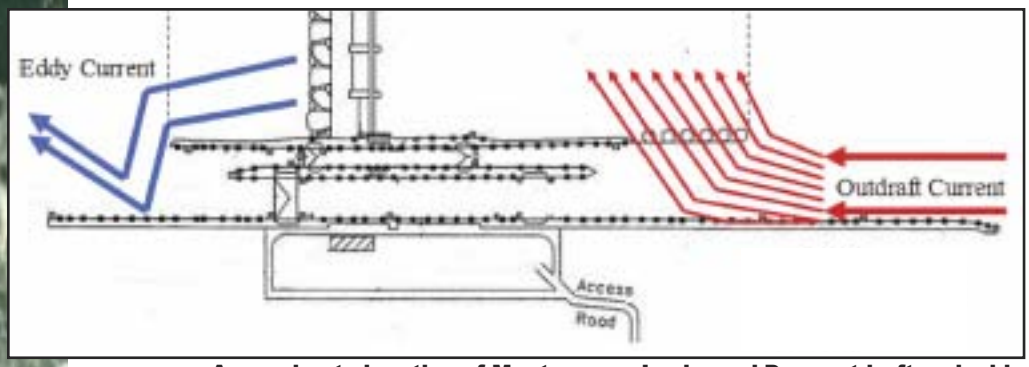
Against the Flow

Strong currents, high water overwhelm a tow.

by Ms. Carolyn Steele
Technical Writer

On January 9, 2005, the pilot of the M/V *Elizabeth M* had successfully locked the upbound vessel and her six-barge tow through the Montgomery Locks and Dam in Beaver County, Pa. It was 1:32 a.m., and though the frigid waters of the Ohio River were storm-swollen and the current was strong, the vessel's pilot had executed what would later be described as "a picture-perfect lock."

So how was it that, less than an hour later, the vessel and her tow would be awash in the roiling waters beneath the dam, with four of her seven crewmembers drowned?



Approximate location of Montgomery Locks and Dam outdraft and eddy current. All graphics USCG.

TIMELINE OF EVENTS

On the night of January 8, 2005, the crew was tasked to pick up six loaded coal barges from Georgetown, Pa. and deliver them to Tonomo, Pa., upbound on the Ohio River. There were seven crewmembers aboard: a captain, a pilot, a striker-pilot (or apprentice pilot), and four deckhands. The vessel's owner/manager ordered another towboat, the M/V *Richard C*, to get in tow to help deliver the barges.

At about 11 p.m. on January 8, the crew on the *Elizabeth M* completed building the tow, consisting of six open loaded coal barges, configured three barges long by two barges wide. The vessel left Georgetown without waiting for the *Richard C*, which was still en route downriver.

Just after midnight on January 9, the weather worsened and river levels began to rise. At 1 a.m., the pilots of the two vessels talked via radio to establish a passing agreement. The vessels safely passed near Shippingport, Pa., at mile marker 34.5 on the Ohio River; the *Elizabeth M* was upbound, the *Richard C* downbound. During the conversation, neither pilot mentioned previous orders to get in tow with each other in Georgetown.

Effects of the Outdraft

At 1:32 a.m., the *Elizabeth M* had completed entry into the main chamber at Montgomery Lock, having executed a "knockout" lockage—that is, the vessel was moored with her starboard side to the stern barge in the tow's port string.

While the tow was in the lock chamber, lock personnel raised the dam gates from 83 feet to 89 feet, increasing the flow rate over the dam by about 13,000 cubic feet per second—in turn, raising the outdraft at the upper

approach to the lock. Nine minutes later, lock personnel had cleared the tow to exit the Montgomery Locks. The vessel's striker-pilot, who had assumed the conn from the pilot, started to move the tow out of the lock, upbound on the river. The pilot ordered the lead deckhand to release the line between the land side of the lock and the tow.

By 1:54 a.m., the striker-pilot had begun maneuvering the vessel to face up to the tow on the fly. The towboat had pushed the six barges approximately 200 feet out of the lock chamber before moving around to the stern of the tow to face up. This maneuver was done on the fly, while the tow was adrift, because the line between the lock and the tow had been released.

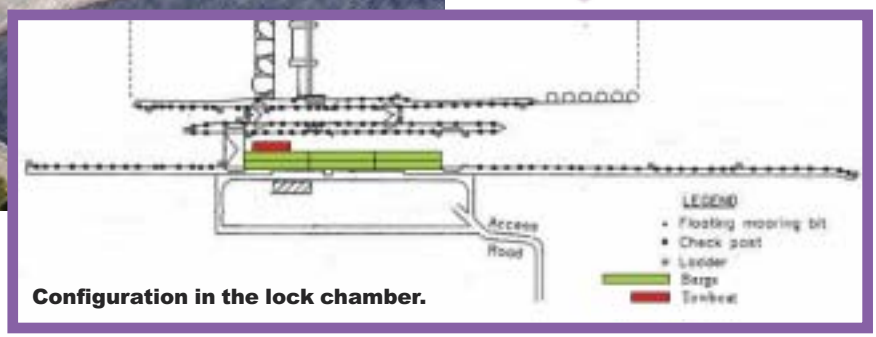
The effect of the river's outdraft was suddenly felt at the head of the tow, the tow became out of shape, and the current began to push it out toward the center of the river. Just after the tow was faced up, the deckhand on the front watch noticed that the head of the tow was headed out and the stern of the boat was riding against the land wall.

At 2:02 a.m., just after departing the lock chamber, the tow's front barges allided with the upstream bull nose at the end of the middle lock wall. The allision caused all but one of the wires tying the front two barges to the rest of the tow to break away, as the towboat continued to push the other four barges out of the lock chamber. The lead deckhand on the forward watch placed a line between the starboard stern of the lead barge and the starboard bow of the center barge in the starboard string in an attempt to keep the barges at the head of the tow from rounding to. After the allision, the towboat and tow continued making headway upstream, angling out toward the center of the river.

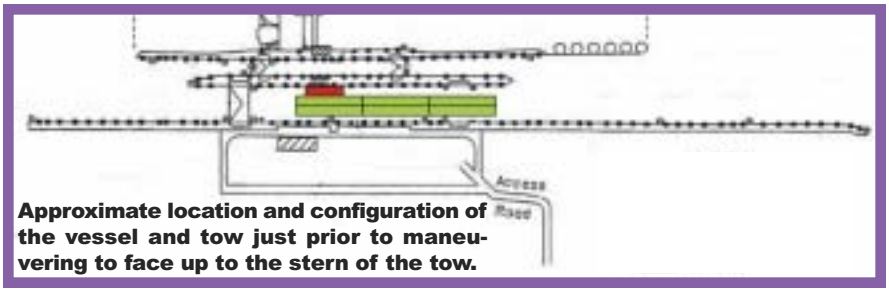
Fan Your Rudders

Within a few moments, the general alarm was sounded aboard the towboat. At 2:06 a.m., the tow allided with the riverside lock wall at the end of the upstream mooring cells. This allision parted the line securing the starboard string lead barge in the tow, which then swung all the way around in front of the port string lead barge, resulting in a bow-to-bow configuration. This also caused the two head barges to wrap around the mooring cells, and end up facing downstream toward the dam.

When he saw this happen, the lock leader contacted the towboat via radio to ask if they needed assistance. The vessel replied, "… I think we got it under control, I think we can han-



Configuration in the lock chamber.



Approximate location and configuration of the vessel and tow just prior to maneuvering to face up to the stern of the tow.

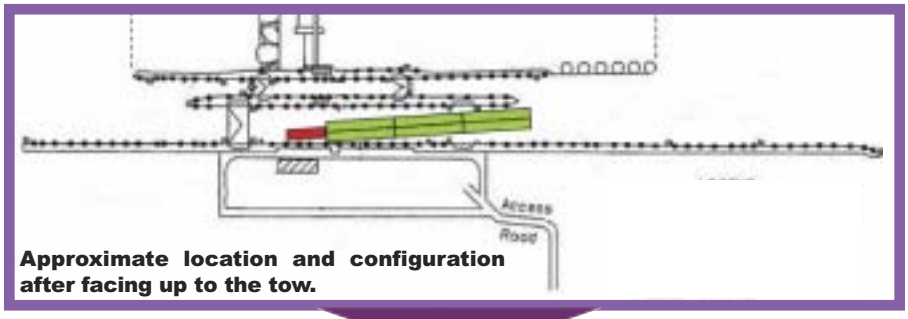
dle it . . .” Two of the lock personnel then opened dam gates two and nine, in case the tow broke away from the vessel. This could allow any free-floating barges to pass over the dam more easily. The captain returned to the wheelhouse, having been awakened by the alarm. He noticed that the towboat was swinging toward the landside lock wall, and directed the lead pilot, “Fan your rudders. Steer to starboard.”

Moments later, the towboat’s starboard quarter allided with the landside lock wall. This tore a starboard chock off the towboat and caused all of the facing wires between the vessel and her tow to separate, except for the port-facing wires. The tow continued to rotate around the end of the riverside lock wall, heading toward the dam.

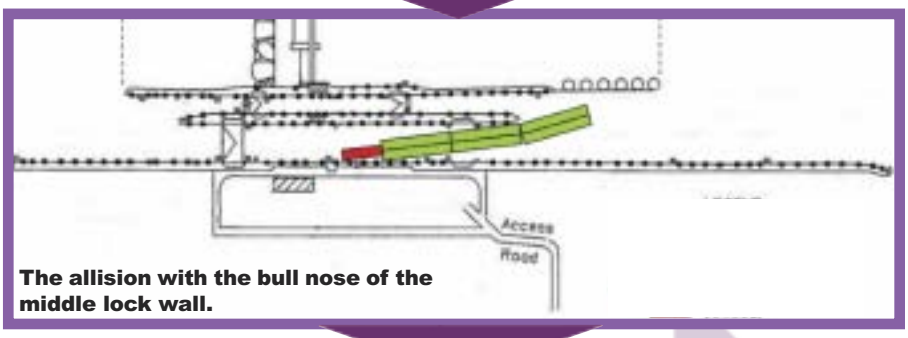
The captain now took control of the towboat from the pilot. He maneuvered the towboat to the port stern corner of the stern barge in the port string, using a line to secure her bow to the tow in an attempt to push the tow upriver to mooring cells above the upper end of the landside lock wall.

From Bad to Worse

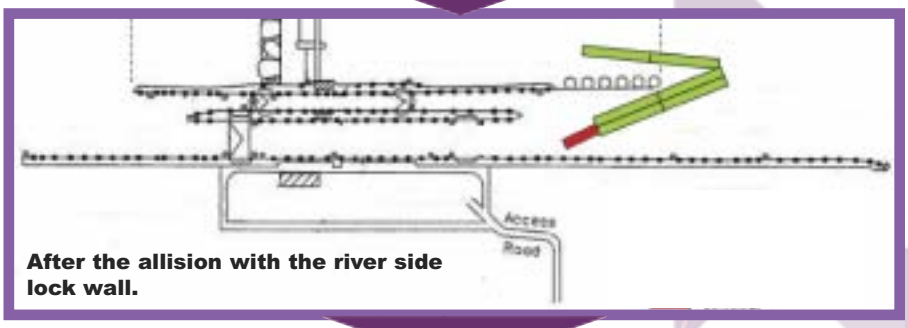
Sometime between 2:06 and 2:10 a.m., the pilot on the *Richard C* spoke with the pilot on the *Elizabeth M* on the telephone, informing him that he could not proceed upstream because of strong currents. The pilot on the *Elizabeth M* told him that he had two barges “hanging over the outside wall” and that he could not talk.



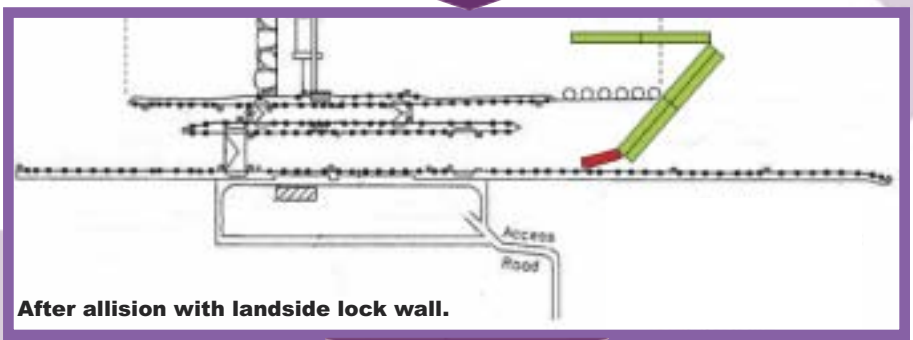
Approximate location and configuration after facing up to the tow.



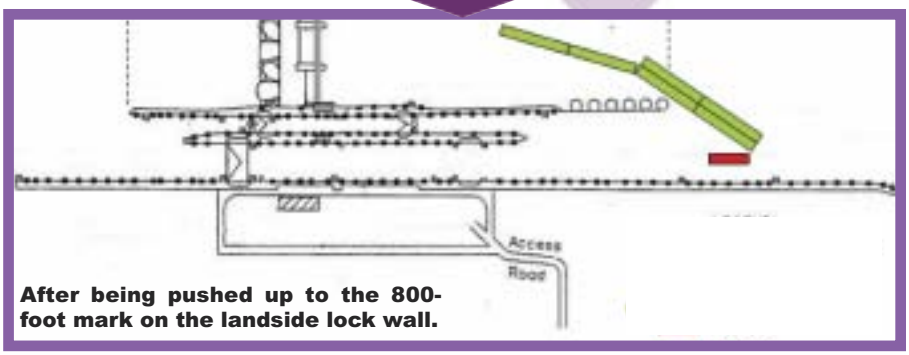
The allision with the bull nose of the middle lock wall.



After the allision with the river side lock wall.



After allision with landside lock wall.



After being pushed up to the 800-foot mark on the landside lock wall.

By 2:14 a.m., the towboat had pushed the tow up around the 800-foot marker on the landside lock wall. The deckhand on the front watch reported to the wheelhouse that the stern barge in the port string was sinking. Fearing the sinking barge might cause other barges or the towboat to sink as well, the captain ordered the deckhands to release the sinking barge from the rest of the tow; however, this proved impossible because the wires securing the sinking barge had tightened up as the barge lost freeboard.

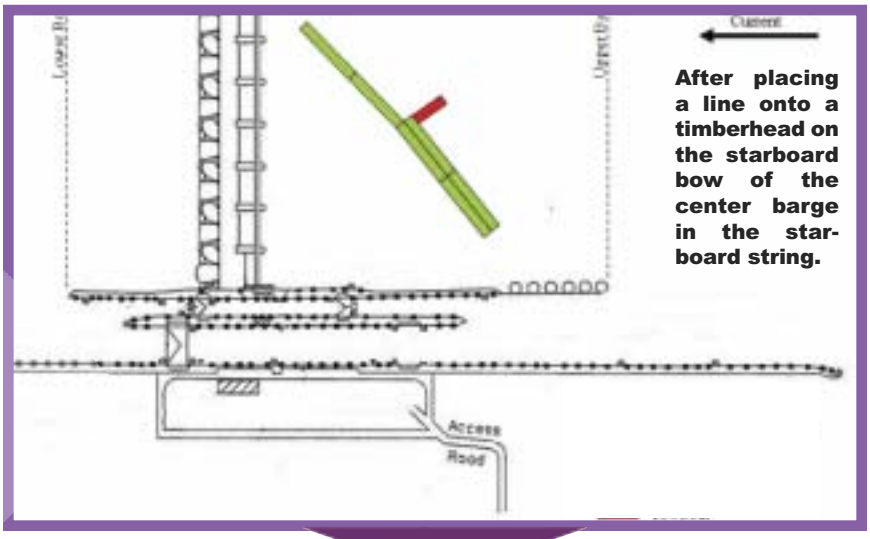
At 2:18 a.m., as the barges flowed with the strong current toward the middle of the river and the dam, the captain moved the vessel from the port side around to the starboard side of the tow, where deckhands tied a line to a timberhead on the middle barge. By this time, the tow had drifted inside a dangerous restricted zone just above the dam—an area of strong currents, now intensified by the high water conditions.

Better Turn it Loose

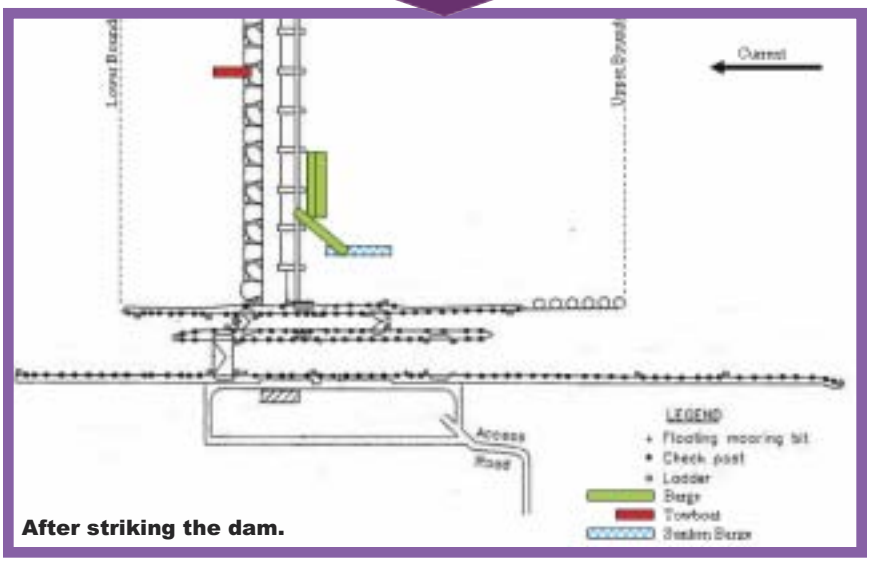
The captain now tried to turn the towboat to port to spin the bow upstream by going full astern on the port engine and greater than clutch ahead on the starboard engine. While the vessel was swinging to port, the starboard side of the vessel collided with a center barge, pinning her to the tow. At this point the pilot advised the captain, "Better turn it loose."

The captain ordered the lead deckhand to release the tow, which he did. The deckhand later told the Coast Guard: "… as soon as I got back on the boat, the boat started rising up in the air." Once more, the captain tried to turn the vessel to port, again causing her starboard side to collide with a barge, and again pinning her to the tow.

At 2:20 a.m., two of the barges went over the Montgomery Dam. Seconds later, the towboat struck the dam sideways at a 45-degree angle on her starboard side, then spun and went over the dam stern first, through the gate six spillway. After going over the dam, the stern of the vessel submerged, then resurfaced and drove her bow into the outflow coming through the spillway.



After placing a line onto a timberhead on the starboard bow of the center barge in the starboard string.



After striking the dam.

The bow then resurfaced, the stern re-submerged, and the towboat sank almost immediately. The vessel came to rest between dam gates five and six. The four barges that remained in the pool above the dam eventually sank. The other two barges that had gone over the dam finally came to rest near mile marker 33.5 on the Ohio River.

SURVIVOR ACCOUNTS AND RESCUE/RECOVERY OPERATIONS

At the Coast Guard hearing on January 20, 2005, survivors and rescuers gave vivid accounts of chaotic moments, split-second decisions, and courage under pressure. Crews on three towboats operating in the area—the M/V *Rocket*, the M/V *Sandy Drake*, and the M/V *Lillian G*—immediately answered distress calls and heroically carried out res-

cue/recovery operations. At the Coast Guard hearing later that month, the three crewmembers who survived the accident—the captain, a forward watch deckhand, and an after watch deckhand—shared their perspectives of what had happened during the critical time before and after the towboat went over the dam.

Going Over the Dam

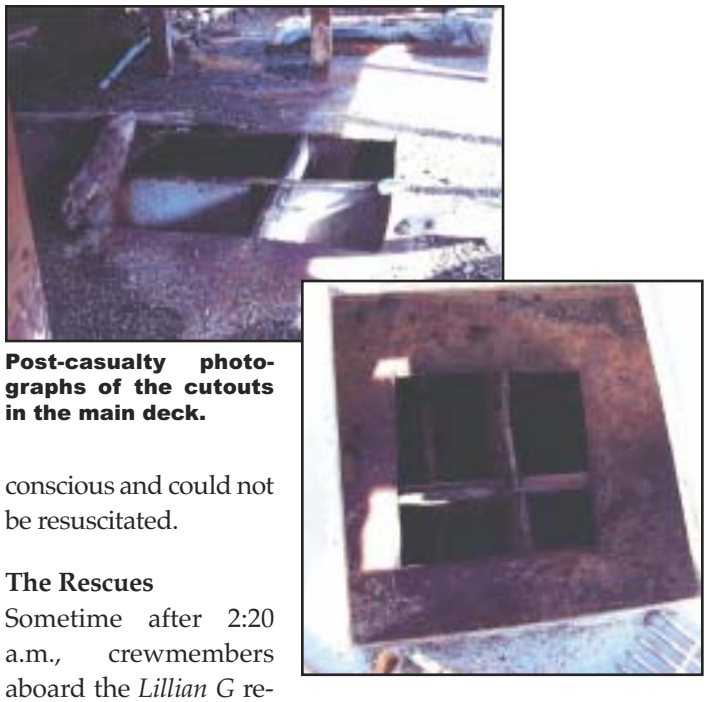
The captain had left the bridge to get his lifejacket when the towboat approached the dam. He arrived back in the wheelhouse just as the vessel went over. Freezing water swiftly flooded the interior, and he saw the pilot and one of the deckhands exiting through the port door.

As the captain struggled to get out of the wheelhouse, water pressure slammed the door shut, amputating the little finger of his right hand and knocking him backward. The door then abruptly popped back open and he was able to escape the wheelhouse. He fought his way over to the stern ladder and tried to hold on to a drain on the top of the wheelhouse with his good hand. The lead deckhand found him shortly afterward, and helped him hold on to an outside ladder until the crew of the M/V *Rocket* rescued both men in the churning water beneath the dam, using ring buoys attached to lifelines.

The lead deckhand ran up the exterior steps on the port side to the wheelhouse just before the towboat went over the dam. As he entered the wheelhouse he saw the striker-pilot and the pilot, who was still trying to maneuver the vessel. Both main engines were at full ahead.

Moments later, he saw the pilot leave the wheelhouse. The deckhand turned and saw the captain return to the wheelhouse, but when he turned around a second later, the captain was gone. As the towboat passed under the lock gate, the top of the wheelhouse made contact. The deckhand tumbled onto the deck and was washed out of the port door by the raging, freezing water beneath the dam. He grabbed the handrail and made his way around to the stern of the wheelhouse to the outside ladder that led to the top of the wheelhouse. The ladder had been torn from the deck and was bent to a vertical position. Though it was still attached to the top of the wheelhouse, it was so damaged that the deckhand could not use it to climb any higher on the vessel, so for over an hour he just hung on—bravely assisting his injured captain, providing him with extra clothing and maintaining radio contact with rescuers—until help arrived.

The other three deckhands were on the head of the vessel as it went over the dam into the Ohio River. Just before they could reach the wheelhouse, the top of the towboat hit the dam gate, so they jumped off the second deck into the yawl on the stern deck. While struggling to release the yawl, they were washed overboard. One of the deckhands, swept downstream by the powerful current, found a floating garbage bag to hang on to for flotation until he was rescued. The other two deckhands were also recovered from the turbulent water, but were unconscious and could not be resuscitated.



Post-casualty photographs of the cutouts in the main deck.

The Rescues

Sometime after 2:20 a.m., crewmembers aboard the *Lillian G* recovered an unconscious man from the Ohio River, administered first aid, and took him to emergency medical service personnel at the Mansfield Power Plant near mile marker 34. Ten minutes later, the M/V *Sandy Drake*, approximately one mile downstream from the Montgomery Locks and Dam, heard three mayday calls and went to help. About 20 minutes later, the *Sandy Drake* arrived below the dam. Her crew risked their own lives to recover three of the towboat's crewmembers (one conscious and two unconscious) and administered first aid, rushing them to emergency medical service personnel at the Mansfield Power Plant.

The last time anyone aboard saw the striker-pilot, he was leaving the wheelhouse just before the vessel went over the dam. Crewmembers later testified they believed he was going below to get a life jacket.

At 2:50 a.m., the U.S. Coast Guard captain of the port (COTP) at Marine Safety Office Pittsburgh established a safety zone between mile markers 31 and 35 on the Ohio River. This part of the river was closed four days for search and rescue operations. Rescue and recovery

operations conducted immediately after the accident failed to locate the striker-pilot. It was not until the towboat was raised on March 4, 2005, that his body was recovered in the vessel's engine room.

Four men died as a result of the accident: the towboat's pilot, the striker-pilot, a forward-watch deckhand, and an after-watch deckhand. All survivors sustained multiple contusions and hypothermia. The official cause of death for all four victims was recorded as drowning.

CONTRIBUTING FACTORS AND ANALYSIS

Improper Modification of the Vessel

The Coast Guard investigation revealed that the towboat's construction likely played a deadly role in the casualty. It was discovered that modifications had been made to the towboat before the accident, which were neither in accordance with manufacturers' specifications nor good marine practice. These alterations reduced the vessel's survivability and degraded her propulsion system capabilities.

After the vessel was salvaged, there was evidence of significant downflooding of interior spaces before she went over the dam. Improper modifications, which included over-ballasting of the vessel in 1997 and two cutouts found in the aft main deck, increased this downflooding and made the vessel sink faster after going over the dam.

The poop deck had been modified when an open grating was installed. This grating replaced approximately 30 inches of the stern section of the deck, and compromised the vessel's weather/water tightness. Any water shipped on the poop deck would have drained directly into the vessel's interior through the grating and the two uncovered cutouts found in the main deck. Hatch dogs were also found to be unserviceable. As stated in the post casualty analysis, with the two cutouts in the main deck:

" . . . Given 60 seconds and some combination of static head and river flow, the aft void could have been mostly (if not completely) full of water."

Inaccessibility of Lifesaving Equipment

Although it might be easy to criticize certain crewmembers' failure to don life jackets prior to the time that disaster struck, it is worth noting that access to the life jackets was a material factor as well. The life jackets were below deck, and precious moments spent trying to retrieve them contributed to the unfortunate outcome. Nevertheless, given the hazardous condition of the river that night, those crewmembers' failure to don life jackets from the outset of the voyage may have cost lives.

Communication Errors

The written policy of the vessel's owner did not describe the responsibilities of the striker-pilot—indeed, the policy never used or defined the term "striker-pilot." However, the policy described the qualifications, responsibilities, necessary training, skill requirements, and other criteria for a pilot trainee or steersman. The policy further provided that this person should steer the vessel only under the direct supervision of the captain, and that overseeing the training was the responsibility of the vessel's captain.

At the hearing, the captain testified he was not aware of this policy. In any event, it is clear that owner/operator's expectations or policies, written or otherwise, did not include company oversight to assure that its guidelines were properly communicated and carried out faithfully.

Vessel orders issued by the vessel's owner/operator on the night of January 8, 2005 were also unclear. A handwritten facsimile sent over to the *Elizabeth M* that night simply stated, "The *Richard C* will help." This order, when read on its own without the benefit of reviewing the *Richard C*'s orders, neither gave enough detail about what help the *Richard C* would provide, nor explained when the help should be provided.

"I think we got it under control, I think we can handle it."

However, looking at the vessel orders together, and bearing in mind the radio conversation between the captain and pilot of the two towboats after the orders were issued, it is clear that the *Richard C* was assigned to be an assist vessel for the entire voyage between Georgetown and Tonomo. But if there was any doubt about the intended assistance, that uncertainty began with the shorthand orders from the owner/operator.

Crew Errors

Overconfidence. The striker-pilot, pilot, and captain were highly qualified, Coast Guard-licensed mariners, with many years of experience among them. Perhaps this contributed to an attitude of overconfidence.

As events unfolded, however, these crewmembers had several opportunities to make decisions that might

have averted such a catastrophic outcome. The Coast Guard cited the decisions that allowed the chain of events to continue and result in the sinking of the vessel and its tow, as follows:

- the decision of the striker-pilot to continue pushing the tow out of the lock chamber after the first allision, toward the open river, before regaining full control of the barges at the head of the tow;
- the decision of the pilot to remove the line that had been secured between the riverside lock wall and the tow after the second allision;
- the decision of the captain to push the tow out of the relatively protected area between the landside lock wall and the riverside lock wall into the open river in an attempt to reach the mooring cells above the upper end of the landside lock wall after the third allision;
- the decision of the captain to pursue the barges into the restricted zone above the dam;
- the decision of the captain to swing the towboat around to point the head of the towboat upstream before beginning to maneuver away from the tow just prior to the tow alliding with the dam instead of backing the towboat away from the tow.

The time taken attempting to execute this last maneuver reduced the amount of time available to maneuver the towboat away from the tow and reduced the distance between the towboat and the dam. Based on testimony from the captain, it appears he was used to performing this maneuver because he considered the maneuver to be normal and had performed the maneuver, in his words, " . . . well into the hundreds of times. Maybe thousands."

Failure to Follow Procedure. Another cause of this casualty was the departure of the tow from the Georgetown fleet without the assigned assist vessel. The report stated that there was evidence that the captain of the downed vessel disobeyed company orders by departing the Georgetown fleet without the assist vessel in attendance; also on the part of the pilot on the *Richard C* for failing to act when he realized the *Elizabeth M* and tow had departed the Georgetown fleet. The vessels' operators further contributed to the casualty by failing to allow ample time for the *Richard C* to arrive at the Georgetown fleet in time to assist in building the tow, or to be standing by when the vessel was ready to get underway after building the tow.

The report went on to state that captain of the towboat was negligent in that he failed to recognize a risk of allision existed until shortly before the tow allided with the dam. He realized this only after the pilot advised him, "Better turn it loose." There was also evidence of misconduct on the part of the captain for pursuing the tow into the dangerous restricted area above the dam.

The towboat's captain further contributed to the casualty by not complying with U.S. Corps of Engineers procedures. Navigation Notice No. 1-2004, paragraph 14 of the Operational Aspects section states: "For a single lockage, with a towboat only set over . . . a lock operator walks a line out with the tow until the towboat is again secured to the tow."

The towboat first started to lose control of the tow during the two- to three-minute time period when the vessel was attempting to get faced up to the tow on the fly, while exiting the lock chamber. It was during this critical time that the captain ordered the tow to be set adrift with no lines between the tow and towboat or between the tow and the lock/guide wall. Once the tow was out of shape and had drifted into the restricted area above the Montgomery Dam, the towboat could not have recovered the barges because the vessel's engines lacked the power to fight the violent outflow above the dam.

In retrospect, the incident reads like a slow-motion train wreck. At each step of the disaster, things seemed manageable—until the moment when the disintegrating tow was swept into the fast-moving current. The decision to go after the barges was the critical "point of no return" for the towboat's captain. It can be seen as an act of desperation to save the wayward barges. It was likely borne out of a single-minded desire to avoid the significant loss of property that now seemed likely to occur.

Overwhelmed by his sense of responsibility, the captain of the towboat made the fateful decision to try to catch up to the barges, re-hook up to them, then drag them upstream—all this in a vessel that did not have the power to outrun the current on its own, much less with several barges positioned broadside to the current in tow.

"The incident reads like a slow-motion train wreck."

Water and Weather Conditions

There had been a great deal of rain in the area prior to the accident. Both the high

water conditions on the upper Ohio River and the outdraft at the upstream approach to the Montgomery Locks and Dam made the scenario less predictable for the unfortunate mariners on the Ohio River that early morning in January.

The towboat's crew would have been better prepared had they received an unequivocal message about water conditions that night. However, the U.S. Coast Guard, the U.S. Army Corps of Engineers, and the marine industry were all using different standards for determining high water conditions on the upper Ohio River.

Post-casualty photograph of the ladder leading to the top of the pilothouse used by the deckhand to secure himself and the captain until they were rescued.

The Ohio River Valley Waterways Management Plan did address high water, but was ineffective in protecting against casualties during high water conditions. The plan had specific trigger points and actions to be taken during low water conditions, but oddly no trigger points for actions to be taken during high water conditions.

In this example, during the high water conditions, inter-pool traffic was only limited by lock outages and inadequate bridge clearances resulting from the high water conditions. Although the Coast Guard had authority to restrict navigation as needed, actions taken as river levels rose above normal at the time of the casualty were left to the discretion of the vessel's crew.

COAST GUARD RECOMMENDATIONS

High Water. The first recommendation outlined steps to be taken to avoid confusion caused by differing standards disseminated by agencies, advising the U.S. Coast Guard, the U.S. Army Corps of Engineers, and industry stakeholders to develop a single definition of "high water," a process for determining when it exists, and to establish trigger points to initiate actions when river levels rise and fall.

The noted definitions, trigger points, and actions were included in the updated Mississippi River and Tributaries Waterways Action Plan and annexes.[1]

Administrative Actions. The second recommendation directed an administrative action investigation against the U.S. Coast Guard license issued to the captain of the *Elizabeth M* and the pilot of the *Richard C* for negligence and/or misconduct.

The master of the *Elizabeth M* was issued an 18-month suspension and an 18-month probationary period following the incident. The pilot of the *Richard C* was issued a letter of warning.

Additional recommendations directed at the vessel's owner/operator mandated:

- inspection of all other vessels in their fleet to ensure all vessel modifications have been completed in accordance with good marine practice and meet or exceed minimum manufacturer's specifications;
- insistence that the company implement a system to ensure their vessel operators are aware of, and comply with, policies and procedures such as the U.S. Corps of Engineers navigation notices;
- a system to ensure vessel movement orders are clearly articulated and not subject to misinterpretation by their vessel operators;
- a review and revision of company policy for scheduling vessel movements to ensure adequate time is allowed for executing the orders;
- a review and revision of the company's pilot trainee or steersman program policy to reflect commonly used terminology and ensure it is clearly understood, and complied with, by all affected parties.

Recommendations for the U.S. Army Corps of Engineers included:

- reviewing and revising Navigation Notice No. 1-2004 to ensure the terms used in the policy are clearly defined;

- enforcing compliance with the requirements of Navigation Notice No. 1-2004 by discontinuing the policy of allowing towboats to face up to a tow on the fly without maintaining some type of positive control over the tow;
- ensuring that personnel employed at their locks and dams are familiar with, and comply with, all locking procedures;
- ensuring that commercial vessels comply with all locking procedures.

Lessons Too Late for Some, but Not All

Rather than a simple account of a tragedy, this article could serve as a warning and a blueprint for others to avoid disasters of this nature in the future. For that to happen, all parties involved must take responsibility to assure better outcomes by increasing the effectiveness of safety protocols. Solutions for the future should begin with a shared attitude toward safety by everyone in the maritime industry.

For mariners, the lessons are twofold:

1. When faced with a predicament that is bad but not yet dire, stop and take a moment to think before the situation gets out of control. If the decision makers aboard the towboat had assessed circumstances more thoroughly, or consulted with others before releasing the tow when it was secured to the head of the lock, the situation could have been salvaged—cargo might have been lost, but not lives.
2. Understand that help is available. A mariner should never forget that, despite all of his courage, experience, and skill, nature and circumstances can combine to defeat him without the support of others. Assistance was available to the captain and his crew from the beginning through to the disastrous end, but at each point when it was offered, the decision was made that the problem could be managed because of an "I think we can handle it" attitude. But that go-it-alone mindset, when help was available and very necessary, contributed significantly to the disaster.

Successfully sorting through the causes of this tragedy does not change the fact that four men died and three other men's lives and careers were altered forever. But the odds of a similar catastrophe occurring in the future might decrease if crew attitudes and practices, company policies, and agency standards are rigorously addressed.

Acknowledgments:
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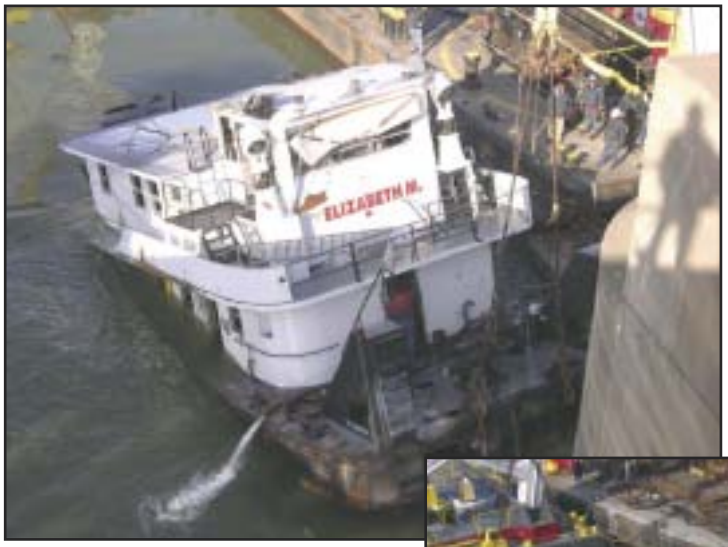
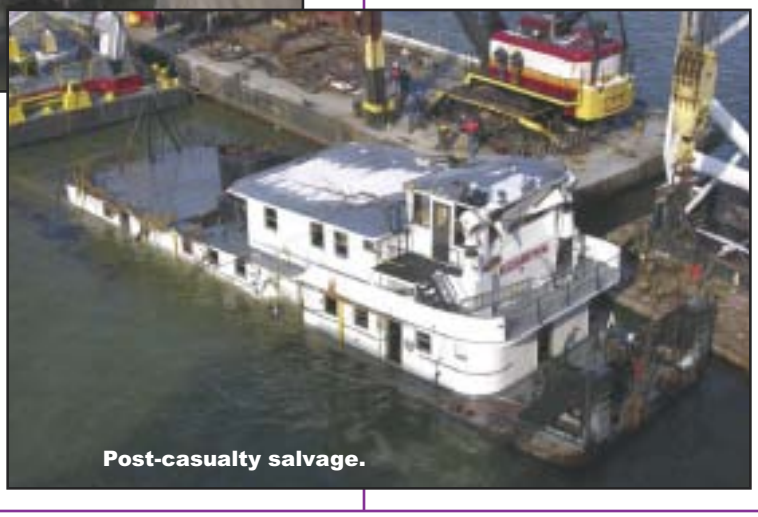
About the author:
Ms. Carolyn Steele has more than 20 years of experience in the communications field. As a writer/editor she has worked on numerous Coast Guard projects since 2006, including the USCG Marine Safety Manual, the USCG Maritime Law Enforcement Manual, and USCG Publication 1. She is the editor and designer of the Crew Endurance Management newsletter.

Endnote:
[1] www.uscg.mil/d8.





Post-casualty salvage.

Flying Blind

Thick fog, faulty communications, and inexperience lead to disaster on the Mississippi.

by Ms. Carolyn Steele
Technical Writer

Navigating the Mississippi River and its tributaries at night can be a challenge for the most experienced mariner, even when conditions are ideal. But combine thick fog and unfamiliarity with the waters, and the outcome can be disastrous.

In a heavy fog just before dawn on February 21, 2004, the 178-foot offshore supply vessel *Lee III* collided with the 534-foot container ship *Zim Mexico III* on the Mississippi River. This incident occurred at Southwest Pass, the only channel leading from the Gulf of Mexico to the Mississippi deep enough to accommodate deep-draft oceangoing ships.

None of the five crewmembers aboard the *Lee III* survived the accident. As a result, nobody from that vessel could give a perspective of the events that led up to the collision. The following accounts are based on interviews with survivors from the other ship—the pilot, captain, and chief mate—as well as radio transmissions from both vessels.

SEQUENCE OF EVENTS

Voyage: Container Ship

The *Zim Mexico III* sails a regular route between Kingston, Jamaica; San Juan, Puerto Rico; Rio Haina, Dominican Republic; Tampa, Fla.; Mobile, Ala.; New Orleans, La.; and Houston, Texas. It takes about 21 days for the vessel to run the entire route. This was the seventh of such voyages the captain had made in his time as master of the vessel.

At 3:46 a.m. on February 21, 2004, the ship and its crew of five arrived at the mouth of Southwest Pass in the Mississippi River, and the pilot arrived aboard. He and the captain discussed the upcoming voyage, the vessel's equipment, the river stage and traffic, and visibility, which at that point was good. As the ship transited the Southwest Pass, the captain was at the starboard radar, the pilot at the port. Two lookouts were posted on the bow.

The container ship was equipped with two fixed VHF radios on the bridge, which the captain set to channels 9 and 16. No radio was set to channel 67, so the pilot tuned his handheld portable radio to that channel.[1] He did not inform the master, and his would be the only radio tuned to channel 67 throughout the voyage. The pilot did not hold his portable radio in his hands at all times. He set it down in the window when he was not using it, five or six steps away from where he was stationed at the radar.

Prior to the collision, the container ship's transit up the river was normal and uneventful. During the trip, the vessel passed several other ships and navigation aids without incident. After the ship passed light 16 at about 5:06 a.m., however, things changed. The fog became much thicker—so much so that the captain and lookouts could not see beyond the bow of the ship 460 feet forward of the bridge.

By 5:15 a.m., the captain began to sound the fog signals, and between 5:17 and 5:19 a.m., he reduced the vessel's speed from 12.2 to 11 knots. At this point the fog had become so thick that the lookouts decided to step down off their platforms, but remained on the forecastle by the anchor windlass to listen for other vessels' fog signals.

Voyage: Supply Vessel

The *Lee III* and crew—captain, mate, engineer, and two deckhands—began the voyage at Venice, La., shortly before 3:00 a.m. on February 21, southbound for Fourchon. The mate was operating the vessel.

Between 3:47 and 3:50 a.m., the vessel's operator made three broadcasts on VHF channel 67, each announcing that it was pulling out of "the Jump"—the waterway connecting point to the river on the west bank side of Venice, La.—and turning southbound on the Mississippi River. In the first transmission, the operator asked a nearby utility boat what radio channel ship traffic stood by on. The watchman told him it was channel 67. The operator responded that he was not familiar with this area of the river, and asked whether he should remain on that channel or go back to channel 16. The watchman told him to stay on 67, because that was the channel ships used, and they could put a secondary radio on channel 16.

As the supply vessel made its way downriver, it encountered a sea-going tug, the *Columbia*, pushing a barge. At about 4:13 a.m., the operator of the tug contacted the supply vessel on channel 67 and said he was on the east bank. The two ships made a one-whistle passing arrangement (port-to-port). At the same time, a coastal tanker, the *Stone Buccaneer*, called the supply vessel, saying that his vessel favored the west bank. The tanker suggested that the supply vessel could "split us." The operator of the supply vessel offered to move over to the east bank to make room for the coastal tanker.

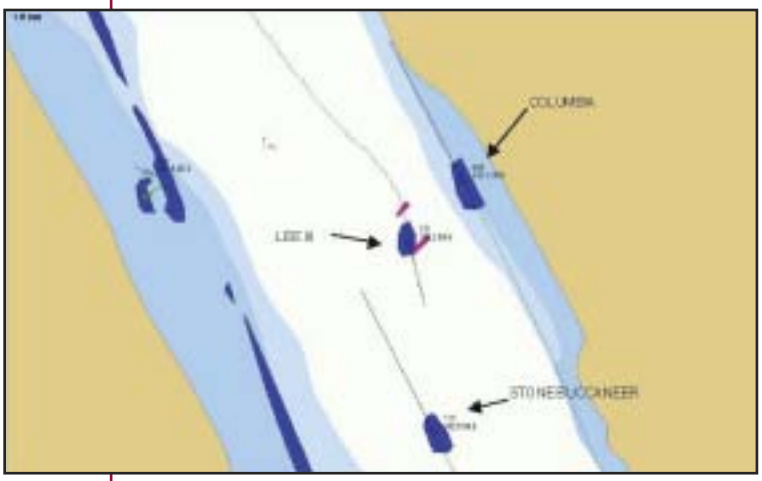
The tanker responded, "I'm slowly overtaking a tow that's northbound; he just agreed to meet you on one. And I'd like to see you on two if that's all right. If you could go down between us, that would be great." The supply vessel agreed to the arrangement, and the coastal tanker said, "Roger, okay. You take the middle; I'll take the west bank; and [the tug] is on the east bank. I'll see you on two." [2]

At 4:17 a.m., the supply vessel said on channel 67, "[Supply vessel] calling that tow," but received no response. The supply vessel then began to turn slightly to starboard and headed downriver to pass the tug port-to-port, as agreed upon earlier.

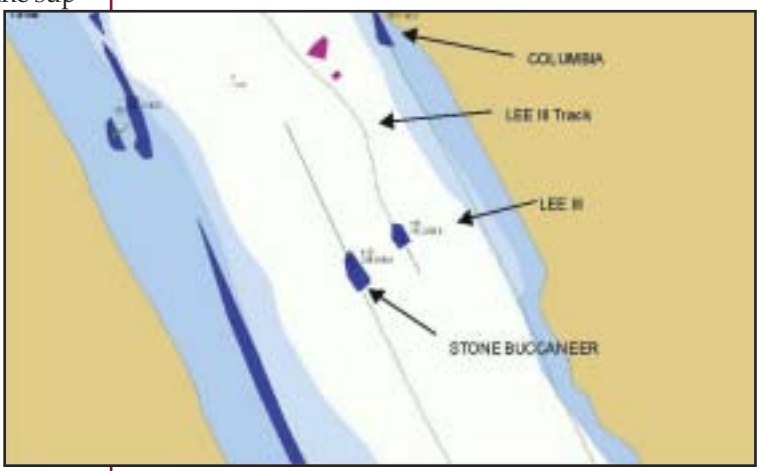
At 4:18 a.m., the supply vessel called again on channel 67, "[Supply vessel] calling both these northbound" while continuing to turn slowly to starboard.

Once more, the coastal tanker told the supply vessel that he was on the west bank. The smaller ship's operator replied haltingly: "Yeah, I'm kinda like in a situation here, uh, I'm not pretty sure where who's who and what's what here. Uh, I mean, you are on the west bank right off my port beam here, over?"

At this point the only vessel off his port beam was the tug, which was on the east bank, not the west bank. The supply vessel was still turning slightly to starboard and closer to the center of the channel.



The supply vessel's position at 4:18 a.m., as the mate turned to starboard and headed closer to the center of the channel.



The supply vessel's position as it passed the seagoing tug, 20 seconds later. This maneuver momentarily put the tug off the supply vessel's port bow as the vessel continued to come around. It was at this point that the mate spoke with the tug's captain and explained that he " ... got kind of nervous ... and swung around here."

The operator of the tanker explained, "No, Captain, that's the east bank. I'm on your starboard bow; you just keep the way you are going. You're meeting a tow right now on one. You're going to meet me on two. I'm on the west bank."

The supply vessel then turned a full 360 degrees to port. At 4:19 a.m., its operator admitted "... actually right now, you're on my port bow. I kind of got nervous here and slowed down and swung around here, over."

We will never know why the operator had become so disoriented. Perhaps he was unfamiliar with the terminology used by the other vessels ("meet me on one"). Possibly he was confused as to which vessel was which because the tow's pilot had identified himself as "Federal 9" instead of by his designation/vessel name.

For whatever reason, the mate took his vessel through a series of maneuvers to pass between the other two ships, despite having ample room. He then continued to travel down the river and entered the narrow Southwest Pass at approximately 4:43 a.m.

Pre-collision Miscommunication, Confusion

By 5:16 a.m. the container ship had continued to make its way northward and came around a slight bend to the west just south of light 19. At that time it was just east of the center of the channel.

The supply vessel now made a general broadcast on Channel 67: "[Supply vessel] southbound in Southwest Pass, uh, coming up on buoy 21, checking on any northbound traffic." [3]

The container ship had just passed mile marker nine and was in the center of the northbound side of the channel. The pilot on the container ship did not hear the transmission.

At 5:17 a.m., the smaller ship called again on the radio, "[Supply vessel], calling this northbound, I'm southbound just coming up on buoy 21 ... Southwest Pass." This transmission differed from the previous one in that the operator now appeared to be hailing a specific vessel (this northbound), rather than making a general broadcast. It is likely that the operator of the supply vessel had now heard the container ship's fog signal or picked it up on radar, and was specifically trying to hail it. Unfortunately, the pilot on the other ship missed that broadcast as well.

The container ship was still negotiating the slight bend in the river and had moved closer to the eastern edge of the channel. It was at about this time that the pilot first detected the supply vessel on his radar, but he assumed it was what he would later term an "anomaly," possibly because the smaller ship was on the east side of the river—not standard practice for southbound vessels on that waterway—or because it was so near the docks on the east bank.

Collision

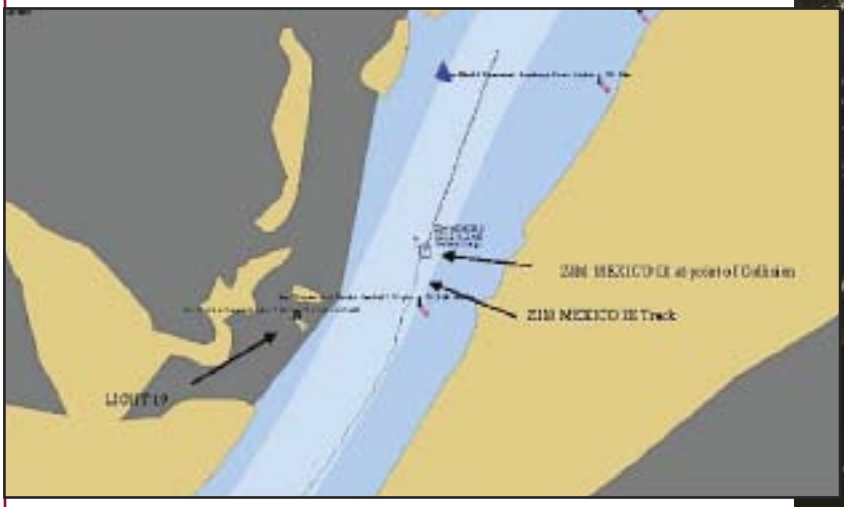
At 5:19 a.m. the container ship began to move away from the eastern edge, toward the center of the channel, and recognized the supply ship as a vessel for the first time because it was clearly moving; it had turned slightly from the east bank of the river and was coming closer to him. Once the operators on the two vessels finally spoke, events unfolded very quickly.

The container ship pilot called the supply vessel on channel 67, and the following exchange took place, beginning less than 40 seconds before the collision:

Supply vessel: "I've been trying to call you on 67 for five minutes."

Container ship: "Okay, I just heard you ... can you get over to that east side for me?"

Supply vessel: "I'm … already pretty much right off your bow … oh … we're, I'm right off your bow, right off your bow!"

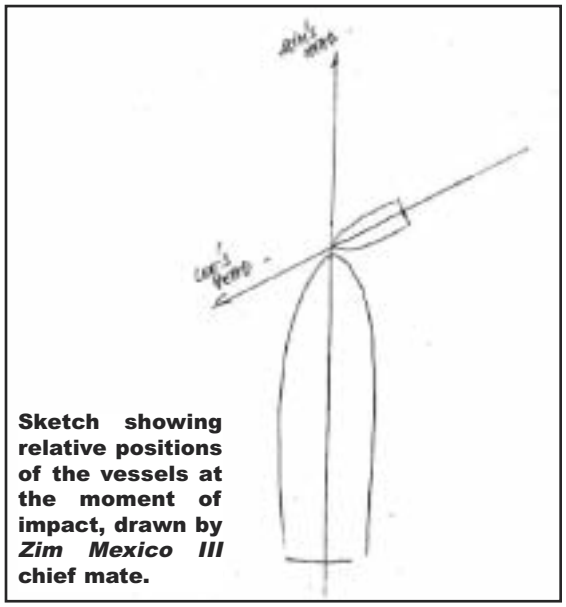


***Zim Mexico III* at the moment of collision.**

Right after his panicked exclamation, the smaller vessel's operator suddenly and inexplicably turned hard to starboard, placing his vessel directly into the path of the larger vessel. The pilot of the larger vessel, realizing a collision was imminent, promptly ordered port 10 degrees rudder, followed by port 20 degrees rudder, but

it was too late. The smaller vessel collided with the container ship's bulbous bow, which struck it broadside, nearly slicing the vessel in half.

At the moment of collision, the container ship was on the eastern edge of the channel, passing light 19 and traveling at 11.2 knots. The supply vessel was also still near the east bank. Had the supply vessel maintained its course and not turned at the last minute, it would have passed the container ship starboard to starboard with about a tenth of a mile's clearance.



Sketch showing relative positions of the vessels at the moment of impact, drawn by *Zim Mexico III* chief mate.

Post-Collision

Immediately following the collision, the container ship captain put his engine to full astern to reduce its speed. On the bow, crewmembers looked down and saw the capsized supply vessel lying parallel to the container ship, a few feet away. They shined flashlights into the water, but could not see or hear anyone. Moments later, the vessel rolled over and sank, swallowed whole by the dark river.

CDR Charles Rawson of Coast Guard Marine Safety Office New Orleans supervises salvage operations for the *Lee III*.

For the next five days the U.S. Coast Guard captain of the port (COTP) at Marine Safety Office New Orleans, La., closed the shipping channel as personnel conducted a search and rescue effort and the supply vessel was removed from the channel.

Divers found the bodies of the captain, the engineer, and a deckhand in their staterooms. The body of the mate who had been operating the vessel was found several days later near the mouth of Southwest Pass. A month would pass before the body of the second deckhand was found near the site of the collision.

The coroner's reports for the five crewmen revealed they had all drowned. Toxicology reports showed no signs of drugs or alcohol in the men's bodies.

No one aboard the container ship was injured.

ANALYSIS

In March of 2004, the Coast Guard held a public hearing to gather information about how the collision occurred. Witnesses included the pilot and captain aboard the container ship and the owners of the two vessels involved.

From these interviews and recordings of VHF channel 67 transmissions made by the operator of the supply vessel, they were able to piece together the factors that contributed to the tragedy.

Human Error

Inexperience. It was clear to the Coast Guard that the primary cause of the accident was inexperience on the part of the supply vessel's mate/operator. In the words of then-Coast Guard Eighth District Commander, RADM Robert F. Duncan:

Salvage effort.

"I must emphasize that there are many contributing factors that ultimately led to the casualty, and just as many opportunities by all parties to perhaps prevent the casualty. It is my opinion that the primary cause of this incident is the inexperience of the waters being transited and lack of required professional qualifications of the mate of the [supply vessel] who was in charge of navigation of that vessel at the time of the casualty."

Though he held a Coast Guard license and despite his five years as a professional seaman, the mate was obviously unfamiliar with this part of the Mississippi River and unsure about some basic rules of navigation.

For example:

- When the mate got underway in Venice, he had to ask the operator aboard the utility boat what frequency he was supposed to monitor, and told the watchman he was not familiar with the waterway.
- He apparently became nervous and disoriented—even to the point of turning completely around in the channel while meeting the tug and the coastal tanker.

- At certain points in his voyage he was transiting on the wrong side of the channel and turning directly into the path of inbound traffic.
- He incorrectly referred to the navigation aids as "buoys" rather than lights.

Faulty Communications. Another major problem was flawed and inadequate communication on the part of both vessels.

The container ship's pilot was probably optimistic in believing that he could monitor all relevant transmissions on channel 67 by employing his handheld radio. Portable radio reception capacity has limitations due to a number of factors, including signal blockage, adjacent channel interference, and antenna configuration.

Unfortunately, the problem may have been exacerbated by the supply vessel mate's rather vague terminology when hailing the container ship ("Calling this northbound"). Had he been more specific—e.g., "Southbound supply ship calling the large vessel northbound"—perhaps the pilot on the container ship would have become aware that he was being called explicitly.

Most importantly, had the supply vessel's operator switched to channel 16—the one used for emergency distress calls—when in such a close-quarters situation, someone else aboard the larger vessel would likely have heard his transmissions and taken action to avert the collision.

Inadequate Supervision/Poor Judgment. The captain of the supply vessel allowed a mate unfamiliar with the routes and hazards to navigate unsupervised in a risky environment. When the vessel was recovered, investigators also discovered that the watertight doors were left open while it was underway.

The captain of the supply vessel had also run aground the day before because of his unfamiliarity with the waterway (see sidebar) and exercised poor judgment when he did not ask for charts. Instead, he allowed the mate, who had even less experience on that part of the river, to conn the vessel alone the next day.

"Hands-off" Attitude of the Supply Vessel Owner/Operator. When questioned during the hearing about the mate's experience sailing on Southwest Pass, the owner/operator of the supply vessel admitted he did not know whether the mate had ever sailed on that waterway before. He insisted, however, that his company did require its captains and mates to have Coast Guard-issued licenses.

When asked if his company had any documents indicating the experience of either the captain or the mate on Southwest Pass, the owner replied the company had only copies of their Coast Guard licenses. He testified later that his company would not normally ask its captains and mates if they had experience in Southwest Pass; rather, he said, "We would assume the captains could navigate through any of these waters with the licenses they have."[4]

When asked if his company ever considered hiring a pilot to go aboard a vessel to assist and advise a captain if he or she expressed unfamiliarity with a particular area, he answered that such a situation "had never come up." If that were to happen, he said, they would try to find another captain who could run the vessel in that area.

Disregarding Inland Rules of the Road. If the supply vessel's

Earlier Trouble Aboard the Supply Vessel

On the evening of Friday, February 20, 2004, just a day before the collision, the supply vessel ran aground near the Gulf entrance to Baptiste Collette Bayou while heading back to Venice, La. from the Gulf of Mexico. The ship had been offshore bringing personnel and equipment to oil platforms in the Gulf.

The captain, who had been conning the vessel, missed the entrance to the channel in Baptiste Collette Bayou by about 100 yards. According to a witness aboard, the captain said he had no charts to indicate the depth of the water in that area, and that he would need to get a chart when they arrived back in Venice.

The captain had asked a nearby ship for help in figuring out his location, how deep the water was, and how far off the vessel was from the channel, but had not called the Coast Guard for assistance. Crewmembers refloated the vessel after 8:00 p.m. by pumping off saltwater previously loaded while offshore. They continued into Baptiste Collette Bayou and went to Venice, La., without further incident, and the vessel seemed to be functioning normally. Unfortunately, the captain did not follow through to obtain the charts.

operator had kept in mind some basic "rules of the road," the story may not have had such a tragic outcome.

Most critically, he overlooked rule 9(a)(i), which requires a vessel proceeding along the course of a narrow channel to keep as near as possible to the outer limit of the channel that lies on its starboard side. At the time of the collision, the supply vessel was actually nearer to the outer limit of the channel off its *port* side.

Further, if the mate had been using his radar effectively—abiding by rule 7(b)—during the period leading up to the accident, he might have well observed the container ship sooner and been able to avoid it.

Weather Conditions

Visibility Problems. The thick fog also played a large role in this calamity. Had the supply vessel's operator seen the container ship sooner, there is a chance he would have been able to avoid it. Likewise, if the two lookouts on the container ship had been able to see the smaller vessel approaching, they could have alerted the captain and pilot before the situation became dire.

INLAND RULES OF THE ROAD

Rule 7: Risk of Collision

(b) Proper use shall be made of radar equipment … including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.

Rule 8: Action to Avoid Collision

(b) Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed should be avoided.

(c) If there is sufficient sea room, alteration of course alone may be the most effective action to avoid a close-quarters situation provided that it is made in good time, is substantial, and does not result in another close-quarters situation.

Rule 9: Narrow Channels

11. (a)(i) [Inld] A vessel proceeding along the course of a narrow channel or fairway shall keep as near to the outer limit of the channel or fairway which lies on her starboard side as is safe and practicable.

Rule 35: Sound Signals in Restricted Visibility

(a) A power-driven vessel making way through the water shall sound at intervals of not more than two minutes one prolonged blast.

COAST GUARD CONCLUSIONS

In investigating what happened, the Coast Guard found several parties to be negligent, violating multiple regulations and basic rules of the road. The investigation itemized specific violations as follows.

Supply Vessel Personnel

Mate/Operator:

- Navigated the Mississippi River without having a first-class pilot aboard or holding a first-class pilot license himself, a violation of 46 CFR 15.401 and 15.812(a).
- Did not properly use the radar on board his vessel to avoid the collision as required by inland rule 7(b), as shown by his failure to establish the location of the container ship as the two vessels approached each other. That he did not take evasive action until the vessels were in extremis indicates that he likely saw the lights of the container ship at the last moment, and only then did he realize that the two vessels were about to collide.
- Failed to use fog signals as required by inland rule 35 (a).
- Failed to switch to channel 16 when the container ship did not respond to his channel 67 VHF transmissions.

Captain:

- Navigated the lower Mississippi River above Head of Passes without a first-class pilot's license. He had not navigated this waterway since 1997, and was clearly unfamiliar with it.
- Violated both 46 CFR 174.210(e) and the requirements of the supply vessel's stability letter in leaving the watertight doors open while the ship was underway.

continued on page 81

Pertinent Regulations
CFR RULES

§ 15.401. Employment and service within restrictions of license or document.

A person may not employ or engage an individual, and an individual may not serve, in a position in which an individual is required by law or regulation to hold a license, certificate of registry, or merchant mariner's document, unless the individual holds a valid license, certificate of registry, or merchant mariner's document, as appropriate, authorizing service in the capacity in which the individual is engaged or employed and the individual serves within any restrictions placed on the license, certificate of registry, or merchant mariner's document.

§ 15.812. Pilots.

(a) Except as specified in paragraph (f) of this section, the following vessels, not sailing on register, when underway on the navigable waters of the United States, must be under the direction and control of an individual qualified to serve as pilot under paragraph (b) or (c) of this section….

§ 174.210. Watertight doors in watertight bulkheads.

(e) If a Class-1 door is installed, the vessel's stability letter will require the master to ensure that the door is always closed except when being used for access.

§ 33 CFR 26.03. Radiotelephone required.

(e) While transiting any of the following waters, each vessel described in paragraph (a) of this section also must have on board a radiotelephone capable of transmitting and receiving on VHF FM channel 67 (156.375 MHz).

§ 33 CFR 26.04. Use of the designated frequency.

(d) On the navigable waters of the United States, channel 13 (156.65 MHz) is the designated frequency required to be monitored in accordance with §26.05(a) except that in the area prescribed in §26.03(e), channel 67 (156.375 MHz) is the designated frequency.

(e) On those navigable waters of the United States within a VTS area, the designated VTS frequency is an additional designated frequency required to be monitored in accordance with §26.05.

§ 33 CFR 26.05. Use of radiotelephone.

Section 5 of the Act states that the radiotelephone required by this Act is for the exclusive use of the master or person in charge of the vessel, or the person designated by the master or person in charge to pilot or direct the movement of the vessel, who shall maintain a listening watch on the designated frequency. Nothing herein shall be interpreted as precluding the use of portable radiotelephone equipment to satisfy the requirements of this act.

§ 47 CFR 80.331. Bridge-to-bridge communication procedure.

(a) Vessels subject to the Bridge-to-Bridge Act transmitting on the designated navigational frequency must conduct communications in a format similar to those given below:

(1) This is the (name of vessel). My position is (give readily identifiable position, course, and speed) about to (describe contemplated action). Out.

(2) Vessel off (give a readily identifiable position). This is (name of vessel) off (give a readily identifiable position). I plan to (give proposed course of action). Over.

(3) (Coast station), this is (vessel's name) off (give readily identifiable position). I plan to (give proposed course of action). Over.

(b) Vessels acknowledging receipt must answer (name of vessel calling). This is (name of vessel answering). Received your call, and follow with an indication of their intentions. Communications must terminate when each ship is satisfied that the other no longer poses a threat to its safety and is ended with "Out."

(c) Use of power greater than one watt in a bridge-to-bridge station shall be limited to the following three situations:

(1) Emergency.

(2) Failure of the vessel being called to respond to a second call at low power.

(3) A broadcast call as in paragraph (a)(1) of this section in a blind situation, e.g., rounding a bend in a river.

Owners/Operators:
The Coast Guard also cited negligence on the part of the supply vessel's owners/operators because they had allowed the ship to operate on the lower Mississippi River without a first-class pilot aboard, and without the captain or mate being qualified to serve as a pilot on those waters.

Container Ship Personnel
Pilot:
He failed to monitor VHF channel 67 as required by 33 CFR 26.03(e)(l) and 26.04(d). He was the only person on the vessel with a radio set to channel 67, yet he missed numerous broadcasts made by the supply vessel announcing its location, that it was heading southbound, and that it was checking on "concerned traffic."

Captain:
He also failed to properly monitor VHF channel 67 on the ship's radios, as required by 33 CFR 26.03(e)(l), 26.04(d), and 26.05. Instead he relied on the pilot's handheld radio, which the pilot did not hold at all times.

LESSONS LEARNED

In every article in this "Lessons Learned" series a consistent theme arises—the need to respect the dangers of the water. This is especially true when navigating in a waterway that is unfamiliar, and—like the Mississippi River—often narrow and fraught with treacherous currents.

Don't Assume Anything

- The owner/operator of the supply vessel assumed that any mariner with a Coast Guard-issued license would be competent to navigate the waters of the Southwest Pass.
- The pilot of the container ship assumed he would be able to hear all channel 67 transmissions, even when he was not holding his portable radio.
- When the pilot first spotted the smaller vessel on his radar only two minutes before the collision, he dismissed it as an "anomaly"—another ill-fated assumption.
- The supply vessel's mate assumed he could evade the larger ship by making a highly risky maneuver without properly functioning radar in almost zero visibility, forgetting Rule 7(c):

"Assumptions shall not be made on the basis of scanty information, especially scanty radar information."

Be Clear in all Communications
It might be common practice among veteran seamen to use expressions like "meet me on one," but it is always safer to make sure the person at the other end of the radio understands you clearly, particularly when you are communicating with a stranger in a situation laden with potential dangers.

If the tanker operator had instead said, "Meet me port-to-port," he would have removed all ambiguity and made his message foolproof.

Come Prepared
However familiar the route, every voyage is potentially hazardous without basic tools.

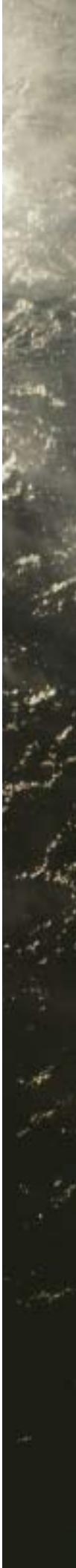
A captain who receives a "warning" in the form of a vessel grounded in unfamiliar waters, then fails to obtain the necessary charts and later places his vessel in the hands of an insufficiently trained mate, is being careless about the lives of his crewmembers and the safety of his vessel.

Use Common Sense

- To make safe decisions for your crew, you must admit your own limitations to your employer or yourself. We will never know if the captain was over-confident, cutting corners, or worried that his employer may replace him, but if there were ever a need for an experienced navigator familiar with a waterway, it was aboard the supply vessel on the Southwest Pass that fateful morning in February.
- Ask for help if you are in trouble. It is better to admit you are having problems than sacrifice your life trying to tackle them alone. The body of the supply vessel's captain was found in his stateroom. This indicates that the mate did not communicate his predicament to his captain, or if he did, he waited too long for the captain to provide help.
- Use basic mariner skills and training at all times to assess risk. Rule 7 addresses the subject of risk of collision. Once you decide this risk exists, rule 8—action to avoid collision—comes into play.
- Always keep in mind the Coast Guard rules and regulations. They are designed to avert such a tragedy as the one described.

AFTERMATH

After this incident, the Coast Guard published a nationwide safety alert reminding mariners of the requirement to keep watertight doors closed when a vessel is underway. Coast Guard personnel also encouraged discus-



sions among representatives in the Eighth Coast Guard District and regional industry organizations on pilotage issues to promote maritime safety.

The accident halted traffic on the Southwest Pass for five days while a search was made for any possible survivors and preparations were made for the salvage of the supply vessel and re-opening of the channel.

As a result, 150 ships were diverted, 65 required to anchor, and at least five cruise ships were trapped, causing the most serious disruption to shipping on the Mississippi for many years and costing millions of dollars in lost revenues. Two-way traffic was not fully restored until March 1, 2004.

The container ship sustained minimal damage to its forepeak and bulbous bow. The supply vessel was raised and sold for scrap.

The loss of the five lives lost cannot be measured.

Acknowledgments:
Proceedings gratefully acknowledges the support of CAPT David Fish, Mr. Charles Barbee, LCDR Paul Rudick, LT Stephen Thompson, and Mr. Ken Olsen of the U.S. Coast Guard Office of Investigations and Casualty Analysis.

About the author:
Ms. Carolyn Steele has over 20 years of experience in the communications field. As a writer/editor she has worked on numerous Coast Guard projects since 2006, including the USCG Marine Safety Manual, the USCG Maritime Law Enforcement Manual, and USCG Publication 1. She is also the editor and designer of the Crew Endurance Management newsletter, and designs the Coast Guard's VRP Review newsletter. Besides writing and graphic design, Ms. Steele has an extensive background in fine art.

Endnotes:

1. Channel 67 is used to monitor river traffic, channel 16 is for emergency distress calls, and channel 9 is for pilot communication.
2. Before radios, ship operators would announce their intentions through whistles; thus, a one-whistle pass would be port-to-port, a two-whistle pass would be starboard-to-starboard. After the advent of radio communication, mariners would still refer to the old method, but abbreviated it to "one" and "two."
3. The operator of the supply vessel mistakenly referred to light 21 as "buoy 21."
4. Neither the mate nor the captain held a first-class pilot's license, and neither had the required number of round trips on the Southwest Pass that would have allowed them to serve as a pilot. Investigators discovered that the captain's last trip to the Southwest Pass had been prior to June 1997, when employed by another company.

Understanding Muds

by Mr. Thomas B. Jordan
U.S. Coast Guard Hazardous Materials Standards Division

What are they?
Drilling fluids, frequently referred to as "muds" that facilitate drilling through rock, are composed of a number of ingredients and have a wide range of physical properties. They are primarily composed of water or oil to which barite, bentonite, brine, and other chemicals are added to achieve desired physical properties, such as density or viscosity.

Muds cool and lubricate the drill bit and drill string, carry rock cuttings up out of the well, and maintain sufficient hydrostatic pressure to preserve the integrity of the well. Muds are frequently thixotropic, which means they become gels when they stop flowing. This aids the drilling process, as rock cuttings become suspended in the mud when drilling must be stopped for maintenance or changing drill bits.

How are they shipped?
Drilling muds are typically shipped as separate ingredients rather than as a mixture. Offshore supply vessels (OSVs), which carry tools and supplies to offshore drilling rigs, have several tanks that are typically filled with the various components.

Why should I care?
➤ ***Shipping concerns.***
Certain muds contain noxious liquid substances. Nearly all offshore service vessels are classified as type 3, which mean that they cannot carry many noxious liquid substances in their tanks. Instead, these substances are transported in separate smaller tanks loaded on deck. The tanks are designed to contain even the nastiest substances and will remain intact even if the vessel sinks or collides with another ship.

➤ ***Health concerns.***
Drilling fluids are not especially toxic, but they can still be hazardous, and there are a number of negative consequences to exposure. The exact effects of exposure can vary greatly depending on the composition of the mud.

Exposure to the skin will generally result in irritation. Respiratory exposure can be more problematic, resulting in respiratory tract irritation, increased phlegm production, and possibly pneumonia. Depending on its composition, mud can also affect the nervous system and cause headache, nausea, dizziness, trouble concentrating, lack of coordination, memory problems, and narcosis.

➤ ***Fire or explosion concerns.***
Some drilling fluids contain combustible ingredients, such as diesel or other hydrocarbons. Vapors from such flammable liquids can easily accumulate in confined spaces, resulting in a serious fire hazard. The tanks these materials are stored in should have a cooling system in place to prevent bursting or explosion in the event of a fire.

It is possible for muds that have no flammable or explosive ingredients to accumulate hydrocarbons in the ground and bring them to the surface. On drilling platforms, drilling muds are exposed to air as they pass through "shale shakers," which are mechanical devices that remove rock cuttings, and in the "mud pits" where the mud is kept before it is pumped back into the ground. Flammable vapors may accumulate in and around these areas, which poses a combustion hazard.

What is the Coast Guard doing about it?
The Coast Guard regulates OSVs under CFR 46 subchapter L and issues certificates of inspection, which are good for five years, subject to annual inspections.

The Coast Guard may also issue a cargo authority attachment, which is a list of cargoes that an offshore service vessel is allowed to carry. These typically apply to hazards cargoes, as there are a number of cargoes that OSVs may carry without specific permission.

About the author:
Mr. Thomas B. Jordan is a sophomore at the University of Maryland, College Park and is pursuing a major in chemical engineering. He is an intern in the U.S. Coast Guard Hazardous Materials Standards Division.

Nautical Engineering Queries

Prepared by NMC Engineering Examination Team

1. **Which statement listed represents a vital function of the main condenser?**

   A. the recovery of feedwater for reuse
   B. cooling of the exhaust steam from the auxiliary exhaust system before it enters the deaerating feed tank
   C. storage of feedwater for immediate use in the boilers
   D. condensing of the exhaust steam from the main feed turbine pumps

---

2. **According to U.S. Coast Guard regulations (46 CFR Part 32), when reach rods to tank valves pass through the deck, the stuffing box at this joint must be _____.**

   A. grounded with bonding straps
   B. watertight
   C. gastight
   D. made of nylon or other non-metallic material

---

3. **When shipboard electrical distribution circuits are connected in parallel, additional parallel circuits will cause the total circuit resistance to _____.**

   A. increase, causing a drop in the line current
   B. increase, causing a decrease in the line voltage
   C. decrease, causing an increase in the line voltage
   D. decrease, causing an increase in the line current

---

4. **Which of the following expresses the relationship of the input and output frequencies in a full wave rectifier?**

   A. The output frequency is the same as input frequency.
   B. The output frequency is one-half the input frequency.
   C. The output frequency is twice the input frequency.
   D. The output frequency is four times the input frequency.

Nautical Deck Queries

Questions

Prepared by NMC Deck Examination Team

1. You have just signed a seaman off your vessel. He has a continuous discharge book. Which statement is true?

A. A certificate of discharge form should be attached to the book.
B. An entry should be made in the book and a certificate of discharge form issued to the seaman.
C. If a vessel was on coastwise articles, the record of discharge will be made in the official log book.
D. The record of entry form must be submitted to the Coast Guard.

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2. The fo'csle card_____.

A. is posted in the crew's quarters and lists the emergency signals
B. advises the crew of the conditions of employment
C. is also known as a Merchant Mariner's Document
D. designates the quarters a seaman will occupy during a voyage

---

3. In reading a weather map, closely spaced pressure gradient lines would indicate_____.

A. high winds
B. high overcast clouds
C. calm or light winds
D. fog or steady rain

---

4. INTERNATIONAL ONLY What is the minimum fog signal required aboard a vessel between 12 meters and 20 meters in length at anchor?

A. rapid ringing of the bell for 10 seconds every minute
B. one short, one long, one short stroke of the bell every minute
C. three separate and distinct strokes of the bell every two minutes
D. any efficient sound signal every two minutes

Engineering Answers

1. A. the recovery of feedwater for reuse — Correct Answer. One vital function of the main condenser is to condense the steam exhausted from the LP turbine and return the condensate to the feedwater system via the main condensate pump.

   B. cooling of the exhaust steam from the auxiliary exhaust system before it enters the deaerating feed tank — Incorrect Answer. Steam from the auxiliary exhaust system is not cooled before it enters the deaerating feed tank (DFT). The thermal energy of the steam is utilized to heat and deaerate the feedwater in the DFT. In addition, auxiliary exhaust steam is utilized as a source of heat for the boiler air heaters and fresh water distilling plant.

   C. storage of feedwater for immediate use in the boilers — Incorrect Answer. The storage of feedwater for use in the boilers is one function of the DFT.

   D. condensing of the exhaust steam from the main feed turbine pumps — Incorrect Answer. Exhaust steam from the main feed pump turbines is discharged to the auxiliary exhaust system. See explanation for choice "B."

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2. A. grounded with bonding straps — Incorrect Answer. Choice "C" is the only correct answer.

   B. watertight — Incorrect Answer. Choice "C" is the only correct answer.

   C. gastight — Correct Answer. 46 CFR 32.50-15(b) states: "Valve operating rods in cargo tanks shall be solid, except that tank barges having plug cocks inside the cargo tanks may have operating rods of extra heavy pipe with the annular space between the lubricant tube and the pipe wall sealed with a non-soluble material to prevent penetration of the cargo. Valve operating rods shall be of ample size, well guided and supported, and attached to the valve stems in a manner so as to prevent the operating rods from working loose. Where the operating rods pass through a deck, gastight stuffing boxes shall be fitted. The leads of operating rods shall be as direct as possible. Valves shall be of suitable design for the intended service."

   D. made of nylon or other non-metallic material — Incorrect Answer. Choice "C" is the only correct answer.

---

3. A. increase, causing a drop in the line current — Incorrect Answer. The resistance decreases when an additional parallel branch is connected to the circuit, and the line current increases. See explanation for choice "D."

   B. increase, causing a decrease in the line voltage — Incorrect Answer. The resistance decreases when an additional parallel branch is connected to the circuit and the line voltage remains constant. See explanation for choice "D."

   C. decrease, causing an increase in the line voltage — Incorrect Answer. Though the resistance decreases when an additional parallel branch is connected to the circuit, the line voltage remains constant. See explanation for choice "D."

   D. decrease, causing an increase in the line current — Correct Answer. The total resistance (R_t) of a parallel circuit may be determined from the following equation:

$$R_t = \frac{1}{1/R_1 + 1/R_2 + 1/R_3 + \ldots\ldots + 1/R_n}$$

   Thus, the more branches you add to a parallel circuit, the lower the total resistance becomes. Further, current is inversely proportional to resistance, and with the line voltage remaining constant, a decrease in resistance will result in an increase in current. Expressed mathematically: $I = E / R_t$

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4. A. The output frequency is the same as input frequency. — Incorrect Answer. A half-wave rectifier conducts once for each full cycle of input voltage. If the rectifier circuit is supplied power from a 60-hertz ac line voltage, 60 pulses of load current will occur each second. Therefore, the output frequency of a half-wave rectifier is the same as the line frequency.

   B. The output frequency is one-half the input frequency. — Incorrect Answer. Choice "C" is the only correct answer.

   C. The output frequency is twice the input frequency. — Correct Answer. A full-wave rectifier conducts twice for each full cycle of input voltage. If the rectifier circuit is supplied power from a 60-hertz ac line voltage, 120 pulses of load current will occur each second. Therefore, the frequency at the output of the full-wave rectifier is twice the line frequency.

   D. The output frequency is four times the input frequency. — Incorrect Answer. Choice "C" is the only correct answer.

1. A. A certificate of discharge form should be attached to the book. — Incorrect Answer.

B. An entry should be made in the book and a certificate of discharge form issued to the seaman. — Incorrect Answer.

C. If a vessel was on coastwise articles, the record of discharge will be made in the official log book. — Incorrect Answer.

D. The record of entry form must be submitted to the Coast Guard. — Correct Answer. As per NVIC 1-86, masters making entry in the continuous discharge book must also prepare a record of entry in the continuous discharge book, Coast Guard form 718E, showing all information entered into the continuous discharge book.

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2. A. is posted in the crew's quarters and lists the emergency signals — Incorrect Answer.

B. advises the crew of the conditions of employment — Correct Answer. It is also known as the forecastle card. At the beginning of a voyage, the master shall have a legible copy of the articles of agreement required by 46 USC 10302, omitting signatures, exhibited in a part of the vessel accessible to the crew.

C. is also known as a Merchant Mariner's Document — Incorrect Answer.

D. designates the quarters a seaman will occupy during a voyage — Incorrect Answer.

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3. A. high winds — Correct Answer. Pressure gradient is a change in pressure over a change in distance. Where isobars (lines of equal pressure) are closely spaced indicates a large change in pressure over a small distance, or a steep pressure gradient. The greater the pressure gradient is, the stronger the wind speed will be.

B. high overcast clouds — Incorrect Answer.

C. calm or light winds — Incorrect Answer.

D. fog or steady rain — Incorrect Answer.

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4. A. rapid ringing of the bell for 10 seconds every minute — Incorrect Answer.

B. one short, one long, one short stroke of the bell every minute — Incorrect Answer.

C. three separate and distinct strokes of the bell every two minutes — Incorrect Answer.

D. any efficient sound signal every two minutes — Correct Answer. Rule 35 of the Navigation Rules states: (i) A vessel of 12 meters or more but less than 20 meters in length shall not be obliged to give the bell signals prescribed in paragraphs (g) and (h) of this rule. However, if she does not, she shall make some other efficient sound signal at intervals of not more than two minutes.

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